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ARMORED
MEDICAL RESEARCH LABORATORY

Fort Knox, Kentucky

Annual Rep. Armored M. Res. Laborat.

ANNUAL HISTORICAL REPORT

1946

Annual Rep. Med. Dept.

ARMORED MEDICAL RESEARCH LABORATORY

Fort Knox, Kentucky

SUBJECT: Annual Historical Report

TO: The Surgeon General
U. S. Army
Washington 25, D. C.

1. The following Annual Historical Report for the calendar year 1946 is submitted for your information:

2. Introduction (Historical Background)

The Armored Medical Research Laboratory was established at Fort Knox, Kentucky, on 1 September 1942.

The Laboratory was operated under the supervision and control of The Commanding General, Army Ground Forces, from 1 September 1942 until 3 February 1944, at which time control and supervision was transferred to the Office of The Surgeon General and the Laboratory designated as a Class IV installation.

Effective 11 June 1946, this Laboratory was redesignated as a Class II installation under the supervision of the Chairman, Army Medical Research and Development Board, Office of The Surgeon General by War Department Circular 169 dated 11 June 1946.

3. Function

Under the general supervision of the Army Medical Research and Development Board of the Office of The Surgeon General, U. S. Army, to conduct research on various physiological and closely related aspects dealing with the inter-relationship between man and his equipment and supplies, disease, his environment and the military tasks assigned to him with the objective of constant improvement. (See Functional Charts, App. A.)

4. Organization

The Armored Medical Research Laboratory is now composed of seven sections comprising Administration, Liaison, Psychology, Physiology (Normal and Abnormal, General and Environmental), Biochemistry, Biophysics and Engineering. (See Organizational Chart, App. B.)

Authorized strength is as follows:

Military	Authorized	Assigned
Officers -	22	19
Enlisted -	27	24
Civilians -	34	29
TOTAL	83	72

Grades and Ratings

Enlisted	Authorized	Assigned
Grade 1 -	1	4
Grade 2 -	2	2
Grade 3 -	3	3
Grade 4 -	4	3
Grade 5 -	8	3
Grade 6 -	6	5
Grade 7 -	3	4
TOTAL	27	24

Civilian

Grade	Authorized	Assigned
P-8	2	2
P-7	3	1
P-6	2	2
P-5	1	0
P-4	4	2
P-3	1	1
SP-7	1	1
SP-6	2	2
SP-4	1	1
CAF-6	1	1
CAF-5	5	5
CAF-4	3	3
CAF-3	3	3
CAF-2	1	1
CPC-3	1	1
Ungraded 24	1	1
Ungraded 19	1	1
Ungraded 15	1	1
TOTAL	34	29

Source of Personnel

Military:

Officer personnel was for the most part composed of ASTP medical officers with special training and experience in medical research fields. These officers were obtained by screening the student classes at the Medical Field Training Center, Brooke Army Medical Center.

This method has been most satisfactory because of the number of young men with excellent scientific backgrounds who have obtained their M.D. degree under the Army Specialized Training Program. It was not at all unusual to find medical officers in this group who also had their Ph.D. degree in Physiology.

Enlisted personnel were for the most part obtained by requisition. The caliber of enlisted laboratory technicians has fallen rapidly with the acceleration of the discharge program in the early part of the year.

Civilian scientific personnel were carefully selected from civilian teaching and research institutions with the view of obtaining a well balanced staff of investigators of known reputation and wide experience in medical research fields.

Civilian personnel in the sub-professional, clerical and custodial grades were obtained through local employment agencies.

5. Physical Plant

The physical plant consists of the following buildings:

1 Permanent Building (Main Laboratory)

12 Frame Buildings (Cantonment Type)
- 6 Two-story Barracks (1 Quarters, 3 Lab. Bldgs., 2 Supply Bldgs.)
- 3 Mess Hall (1 Animal House, 1 Isotope Lab., 1 Storage)
- 1 Recreation Hall (Conference Room)
- 1 Company Supply (Machine Shop)
- 1 Utility Building (Carpenter Shop)

1 Motor Pool (Garage and Maintenance)

The permanent laboratory building is of concrete block construction and is in an excellent state of repair.

Inadequacy oflaboratory and storage space has necessitated the utilization of nearby frame structures which are usable but in poor state of repair. These buildings will be renovated and converted into temporary laboratories.

6. Research Planning

The transition from wartime to a peacetime basis of operation has posed many problems which are undoubtedly common to all branches of the service interested in research development.

Many persons have been at work formulating plans for future research in the armed forces, however, as yet little has been handed down to operating agencies as to the scope of these plans or the means of implementation.

In the meantime, it has been necessary to keep the wheels turning along lines which appear to offer the most in the way of profitable investigation. The global nature of World War II focused belated attention to the fact that little had been done in prewar years to prepare the soldier and his equipment to withstand the rigors of the many varied environmental conditions to be encountered in world-wide theaters of operation. The pressure of war demanded the production of machines of war in huge quantities and there was little time to investigate what the individual could do with them or what additional stresses were placed upon the military man in their operation.

All services suffered alike from this lack of basic information on the physiological and psychological limitations of man in the accomplishment of his military tasks.

The battlefield was the proving ground and many lessons were learned the hard way.

Technological advances in machines of war have far outstripped information and fundamental data on man's ability and requirements to operate them. This fact is now realized more clearly by all branches of the service and more and more influence is being exerted upon design by man's physiological limitations.

The efforts to protect the military man against his environment is a new and rapidly developing science and a number of the services have established laboratories for physiological investigation in conjuction with their equipment testing and development laboratories. The problem is service-wide and it is an important step in the right direction that all branches realize the vital necessity for intensive peacetime research and development.

This laboratory is now concentrating its efforts principally on basic and fundamental investigation of a physiological nature that is applicable to military use. (See Reevaluation Program, App. C.)

7. Accomplishments

a. Reorganization and Restaffing of Laboratory:

The end of the war witnessed the rapid exodus of the highly

trained staff from this laboratory back to civilian positions. By the end of March 1946 only one officer and one enlisted man of the original group remained. By the end of May, the one remaining officer of the original group had departed. The difficult task of reassembling a combined military and civilian staff was of first importance.

As previously stated, the officer staff was gradually recruited from ASTP medical officers just entering the service. This was a fortunate source of officer replacement because of the presence in each group of a number of well trained young scientists who were anxious to continue in research work in various medical fields. Nineteen officers were assigned to the laboratory staff by the end of the year.

Enlisted personnel were recruited from various technical detachments and schools, however, the turnover has been rapid due to lowering of discharge criteria.

The procurement of civilian scientists to head the various departments was much more difficult. Competition with civilian industry was keen. On a number of occasions, mere inquiry as to the possibility of interest of a civilian scientist in working at this laboratory was sufficient to cause a pay increase and betterment of his position in his present location. There was also competition between services and some jockeying by the sought after scientists for the best offer.

The heavy civilian demand for research scientists of established reputations coupled with the post-war civilian reaction against being associated with things military made the restaffing task most difficult. To combat this problem, a prospectus was prepared (see App. D) and sent to well known scientists in teaching and research centers with the request that they be given to civilian scientists who possessed the desired qualifications and who might be interested in the positions offered.

No positions were filled until after a suitable research scientist had been found for the position of Director of Research. This individual was chosen not only because of wide research experience, but also because of his wartime military experience and familiarity with army procedures. After much correspondence and many interviews the civilian staff was gradually built up, one by one.

The problem of housing, schools for dependents and isolation from scientific centers were major difficulties in the securing of qualified civilian scientists.

These scientists all desired some assurance before giving up committments with civilian teaching and research institutions, particularly with regard to permanence of their new assignments and some freedom in their work.

Because of the small number of civilian scientists to be employed, these men were carefully selected, not only from the standpoint of educational qualifications and research experience but also for their versatility and ability to work as a team.

This method of selecting a staff has resulted in a well-balanced and highly efficient group capable of investigation in a wide range of research fields of medico-military importance. All the civilian research scientists have Ph.D. degrees and most of them have had teaching experience.

b. Liaison with Other Laboratories:

The need for close liaison between this laboratory and laboratories of other branches of the service was urgently needed.

Many of these laboratories were interested or actually working on similar problems which meant duplication of effort and expense. Consequently this laboratory began to contact other laboratories directly to exchange ideas and information on problems of mutual interest. An interchange of visitors and observers then began which has resulted in a better understanding of the capabilities and aims of the various laboratories.

Requests for assistance in solving problems are now being received from other branches of the service.

c. Master File of Completed Projects:

During the war, reports on projects completed at this laboratory were given rather wide distribution. With the end of hostilities and rapid demobilization, many officers who had received the reports left the service, new personnel were not familiar with previous work that had been done and files were voluminous. In order to assist offices in keeping up to date on work which had been done here, a master file of all completed projects was prepared and forwarded to everyone on the distribution list. (See App. E.)

This resulted in requests from various sources for hundreds of copies of project reports which were not in their reference files.

It also called to the attention of new personnel what information was available at this laboratory.

Likewise, the distribution list was completely revised after a questionnaire had been sent to every individual and office on the list. Each addressee was asked if they desired future reports and the number desired. Many new addresses were added and all non-interested, or no longer existing offices, were dropped. (See Distribution List, App. F.)

d. Relationship with Local Scientific Institutions:

The rather isolated location of this laboratory away from any large research institution brought early recognition that a strong effort should be made to further all local contacts with scientific bodies and institutions located in this vicinity.

The University of Louisville Medical School has been most cordial and has invited staff members to attend a weekly Seminar at the Medical School. From ten to fifteen members of the laboratory staff attend each week. We also participate in presenting papers and lectures.

Department heads are also lecturing to classes of medical students.

Contact with the Speed Scientific School, University of Louisville, and the University of Cincinnati Medical School has been started in order to further our efforts to remain in contact with the outside.

e. Officers' Club Privileges for High-Graded Civilian Employees:

Many of the high-graded civilian employees of this laboratory expressed a desire to use some of the facilities of the Officers' Club such as the swimming pool, tennis courts, golf course and riding stables. This privilege was particularly desired by those employees with children.

A request for such privileges for selected civilians was made to the Board of Governors of the Officers' Club and approval has been received.

This accomplishment was regarded as an important one in that it has improved the general morale of the employee and his dependents, for whom no such facilities were previously available either on or off the post.

8. Difficulties

It is believed that any detailed report on the operation of this laboratory should include statements on its difficulties and shortcomings with recommendations for their correction.

Some of the difficulties are relatively trivial and will be corrected as general conditions seek a more stable peacetime level.

Other difficulties loom large in their importance, particularly with regard to their effect upon future research activities at this laboratory.

a. Personnel:

As has been previously stated, the present supply of trained military personnel is good but the loss of this source of supply with the ending of the ASTP presents a gloomy outlook.

Due to the absence of qualified medical research officers in the Regular Army or of a program for training such officers, the end of ASTP plus two years will mark the end of research by qualified Medical Department officers.

The research scientist is an individual who, because of his advanced training and experience in a highly specialized field, requires inducements not now possible before he will consider a career in the Regular Army. He desires relative freedom in his field of research, recognition for his ability and accomplishments, and some assurance that he will be allowed to continue his research career in the Army.

He also wishes to maintain his contact with civilian scientists by attendance at meetings and conventions. He wishes to be allowed to take courses at civilian universities to keep up with new advances and to complete work on his degree.

All of these desires are reasonable and in keeping with high standards of research investigation.

While some of these requirements can be at least partially assured, the policy on integration of personnel of this type into the Regular Army is too vague to induce more than a meagre and trusting few to apply for commissions. Competition between industry, university and civilian research centers is keen and the demand for trained scientific personnel is heavy.

9. Location of Laboratory

The isolated location of the laboratory has disadvantages. The original reasons for the location such as availability of troops and Armored Force equipment no longer apply.

The availability of troops is a source of supply for test subjects only, and does not furnish information on troops actually undergoing training in field conditions.

We are not in contact with combat troops but rather a group of soldiers receiving basic training.

Troops are available for test purposes at posts nearer large cities such as Washington or Baltimore.

The scientists working in this laboratory feel the isolation from teaching and research centers.

Existing regulations prevent attendance at scientific meetings at government expense and because of distances and time involved the scientist must limit his efforts to attend such meetings to a minimum.

Location of this laboratory nearer to research and teaching centers would be a distinct advantage and an aid to keeping up contacts with other scientists and with new advances.

It is not possible to have a completely adequate library at this laboratory. Location of this laboratory in or near Washington would

also have the advantage of access to reference libraries such as the Army Medical Library and Library of Congress.

It has been necessary to obtain on loan as many as 500 reference works a month from the Medical Library of the University of Louisville Medical School.

10. Housing Problem

The great difficulty in finding family quarters near this post has been a material factor in increasing the problem of obtaining well qualified civilian personnel.

It is realized that this difficulty is widespread but nevertheless it has in most instances been the deciding factor in the rejection of an offer of employment. Most of the scientists expressed great interest in the laboratory, its policies and equipment, but when the problem of living quarters was discussed their interest waned.

The large demand for quarters on the post by military personnel makes it impossible to obtain quarters for civilian employees.

It is understood that military personnel should receive first consideration, however, the problem remains.

Even though the civilian scientist wishes to work in this laboratory he will not accept the position because of the uncertainty of ever acquiring suitable living quarters in this vicinity. This is particularly true when he owns or has suitable quarters in his present position.

It is believed that this problem is another argument in favor of location of this laboratory in or near a larger city where the turnover of quarters is greater and where the civilian, as well as army personnel, will eventually find quarters near his place of work.

While there will be some relief of this problem for junior officers through the conversion of barracks and hospital buildings into apartments, no relief is in sight for the civilian employee. In the case of this laboratory, the latter are more important because this group form the backbone of the research organization and are more or less permanently employed.

F. J. Knoblauch

F. J. KNOBLAUCH
Lt. Colonel, MC
Commanding Officer

FUNCTIONAL CHARTS

ARMORED MEDICAL RESEARCH LABORATORY FUNCTIONAL CHART

LABORATORY

Functions: Under the general supervision of the Army Medical Research and Development Division of the Office of the Surgeon General, U.S. Army, conducts research on various physiological and closely related aspects dealing with the inter-relationships between man and his equipment and supplies, disease, his environment and the military tasks assigned him with the view of constant improvement.

ADMINISTRATIVE DIVISION

Functions: Supervises, coordinates and performs all duties of administrative nature, which include the following: Personnel; receipt and distribution of mail; preparation, receipt and filing of all military correspondence and records; processing and distributing partial and final research project reports; operation of the medical library; administers the organization and functions of the Medical Detachment; furnishes a clerk-stenographic pool for use by the other branches as required; procures, stores, and distributes all equipment and supplies, both military and civilian, required by the laboratory; provides and maintains transportation for the laboratory; provides drivers for the field testing of equipment and test vehicles; maintains and operates the buildings and utilities, including safety procedures; alters old equipment and constructs new apparatus as required in the operation of the laboratory or in the performance of projects; prepares charts, diagrams or sketches for any phase of work carried on by the Laboratory.

See Chart #3

RESEARCH DIVISION

Functions: Conducts research in physiological anthropometric and psychological factors involving man, disease, military equipment, weapons and supplies, military tasks and environment; engages in research or clinical and physiological problems of heat and cold exposure; carries out projects relating to the prevention and treatment of battle fatigue and war neurosis; designs and evaluates tests for the classification and pre-selection of men for duties in the Army; develops and carries out indicated research in biochemical aspects of physiological and clinical studies; conducts anthropometric research; all work performed with the view of improving the classification and selection of men, their training, and military weapons, equipment and supplies.

See Chart #4

ADMINISTRATIVE DIVISION

MEDICAL DETACHMENT

Functions: Furnishes technically trained personnel to assist in the research branches; furnishes personnel for use as clerks, drivers, and auto mechanics; accomplishes all administrative matters for the detachment, ie. personnel, pay morning reports, etc.

PERSONNEL-RECORDS-STENOGRAPHIC SECTION

Functions: Accomplishes all matters pertaining to personnel, both military and civilian; prepares, processes and files all correspondence and routine and special reports; processes and distributes partial and final project reports, furnishes stenographic pool for other branches; receives and distributes all incoming and outgoing mail

SUPPLY SECTION

Functions: Procures, accounts for, stores, and distributes all equipment and supplies, military and civilian, required by the laboratory; maintains necessary records and vouchers; expedites and traces shipments; conducts frequent inventories of supplies and equipment; maintains files of commercial catalogues.

ENGINEER SECTION

Functions: Remodels all items of equipment or constructs new items for use in experimental procedures being carried out in the research projects of the laboratory; operates a utility section for the maintenance of the grounds, buildings and equipment; operates a shop capable of woodwork, sheet metal work, and the construction of precision items of equipment; responsible for guarding the grounds, buildings and equipment; provides janitor service; drafts, charts, diagrams and sketches incidental to special experimental equipment or other phases of work.

FIELD TESTING-TRANSP.-MAIN.-SECTION

Functions: Administers the motor pool; provides and maintains the authorized transportation; furnishes drivers for the field testing of equipment and test vehicles under the supervision of the research branch conducting the project.

LIBRARY SECTION

Functions: Operates library, obtains technical books and reports, lending them to individuals requiring them officially, assisting personnel in finding technical references and in making literature searches; maintains files of technical periodicals; receives, circulates and maintains files of technical reports from other research agencies; indexes and maintains complete file on each research project accomplished by the laboratory.

Chart #3

RESEARCH DIVISION

Functions: Conducts research in physiological, biochemical, biophysical, anthropometric and psychological factors involving man, disease, military equipment, military tasks and environment. Engages in research on physiological problems of heat and cold exposure. Carries out projects relating to the prevention and treatment of fatigue. Develops and carries out indicated basic research in biochemical and biophysical aspects of physiological studies. The ultimate objectives are to provide sound fundamental data that may be used in clinical research and to provide data that can be applied to the improvement of the selection of men, their training and military weapons, equipment and supplies.

MEDICAL RESEARCH BRANCH

Functions: Guides the various sections in the performance of their research projects, correlates their activities and gives detailed technical assistance in the preparation and publication of reports.

PSYCHOLOGY SECTION

unctions: Cooperates with her sections in their ex-rimental work, devising ychological procedures to valuate the degree of stress laced upon the organism and dvises and assists in the roper employment and evalu-tion of results obtained om these tests. Carries t projects relating to the ychological aspects of the ldier in relation to his ilitary tasks.

BIOCHEMISTRY SECTION

Functions: Institutes and carries out biochemical research projects independently designed or assigned. Develops and supervises special chemical techniques in connection with research programs of the Laboratory. Prepares partial reports and final project reports of completed research activities of the Section.

PHYSIOLOGY SECTION

Functions: Institutes and carries out physiological research problems independently devised or assigned. Coordinates the independent research activities of the Sub-Sections. Assists in the planning of the research activities of the Laboratory in cooperation with the Commanding Officer, the Research Director and heads of the various Sections.

LIAISON-FIELD OBSERVER BRANCH

Functions: Performs liaison and observation of field problems from the field to the Laboratory for subjection to the experimental approach and brings to the attention of officers in the field the practical application of results obtained by investigation in the Laboratory. Prepares reports on these matters.

BIOPHYSICS SECTION

Functions: Assists, consults and cooperates with Laboratory Staff members on research involving physiological, mathematical and physical considerations. Engages in biophysical research on vision, sound, radiation and physical properties of body tissues. Prepares partial and final reports of research activities of the Section.

ENVIRONMENTAL PHYSIOLOGY SUB-SECTION

Functions: Carries out such research activities as may be assigned or as independently designed. Engages in research on physiological problems of heat and cold exposures and develops and tests protective devices and procedures for the environmental conditions under study. Prepares progress and final reports of research activities of the Sub-Section.

GENERAL PHYSIOLOGY SUB-SECTION

Functions: Coordinates activity with other Sections on projects relating to the functional performance of personnel as influenced by anatomical and other physical limitations. Initiates and carries out investigations into anthropometric studies of Army personnel. Prepares partial and final reports on completed research activities of the Sub-Section.

Chart #4

ORGANIZATIONAL CHART

ARMORED MEDICAL RESEARCH LABORATORY
ORGANIZATIONAL CHART

22-O 27-EM 34-CIV

COMMANDING OFFICER
1 – COLONEL MC
1 – CLERK-STENOGRAPHER CAF – 5

CONSULTANTS

4-O 15-EM 16-CIV

EXECUTIVE OFFICER
1 – LT. COLONEL MC

17-O 12-EM 17-CIV

ASSOCIATE DIRECTOR
(DIRECTOR OF RESEARCH) P – 8
1 – CLERK-STENOGRAPHER CAF – 4

2-O 13-EM 8-CIV

ADMINISTRATIVE BRANCH
1 – CAPTAIN MAC*
1 – M/SGT. – CHIEF CLERK 502

*ADJUTANT, DET. CO, PERSONNEL OFFICER

1-O 3-EM 8-CIV

ENGINEERING BRANCH
1 – ENGINEER, GENERAL (CHIEF) P – 6
1 – LT. OR CAPT. BI (ASST ENG.)
1 – ENGINEER UTILITIES P – 3
1 – INSTRUMENT MAKER UNGR-24
1 – DRAFTSMAN ENGINEERING SP – 7
1 – ENGINEERING AID SP – 6
1 – CARPENTER UNGRADED –15
1 – T/4 DRAFTSMAN 070
1 – JANITOR CPC – 3
1 – T/4 MACHINIST 114
1 – MACHINIST UNGR-19
1 – T/4 X-RAY TECHNICIAN 264

15-O 12-EM 15-CIV.

MEDICAL RESEARCH BRANCH
1 – CHIEF RESEARCH PHYSICIAN P – 8
1 – MAJ. MC (ASST. RESEARCH PHY.)
1 – CLERK-STENOGRAPHER CAF – 4
2 – CLERKS, STATISTICAL CAF – 5
1 – T/SGT.-NCO FLD. TEST SUPERVISOR 566

2-O

LIAISON FIELD OBSERVER BRANCH
2 – LTS. OR CAPTS. MC

1-O 27-EM

MEDICAL DETACHMENT
1 – CAPTAIN MAC
26 – ENLISTED MEN

3-EM 2-CIV.

PERSONNEL-RECORDS STENOGRAPHIC SECTION
1 – T/SGT.-ADM. NCO 502
1 – T/3 – CLERK PERSONNEL 405
1 – T/4 – CLERK MESSAGE CENTER 667
2 – CLERK-STENOGRAPHERS CAF – 3

1-O 1-EM 0-CIV.

PSYCHOLOGY SECTION
1 – CAPT MC PSYCHOLOGIST
1 – T/3 LAB TECH MEDICAL 858

3-O 2-EM 3-CIV

BIOCHEMISTRY SECTION
1 – CHIEF BIOCHEMIST P – 7
1 – BIOCHEMIST P – 4
3 – LTS. OR CAPTS. BI-BIOCHEMISTS
1 – SCIENTIFIC AID SP – 4
1 – T/3 LAB. ASST CHEMICAL 411
1 – T/4 LAB. ASST CHEMICAL 411

7-O 6-EM 5-CIV

PHYSIOLOGY SECTION
1 – CHIEF PHYSIOLOGIST P – 7
1 – MAJOR MC PHYSIOLOGIST
1 – T/3 LAB TECH MEDICAL 858
1 – T/4 LAB TECH MEDICAL 858

3-O 2-EM 2-CIV.

BIOPHYSICS SECTION
1 – CHIEF BIOPHYSICIST P – 7
1 – BIOPHYSICIST P – 4
3 – LTS. OR CAPTS BI (PHYSICISTS)
1 – T/3 -LAB ASST PHYSICS 160
1 – T/4 – LAB ASST PHYSICS 160

1-O 8-EM

FIELD TESTING TRANSPORTATION-MAINTENANCE SECTION
1 – CAPT. BI
1 – M/SGT.-FORMAN AUTO REPAIR SHP 337
1 – T/3 MECHANIC 341
1 – T/4 MECHANIC 341
5 – T/5 DRIVERS TRUCK LIGHT 345

2-CIV

LIBRARY SECTION
1 – CHIEF LIBRARY CLERK CAF – 6
1 – CLERK-STENOGRAPHER CAF – 3

4-CIV

SUPPLY SECTION
1 – PURCHASING CLERK CAF – 5
1 – STOCK CLERK CAF – 4
1 – CLERK-STENOGRAPHER CAF – 4
1 – STOCK CLERK CAF – 2

3-O 2-EM 3-CIV.

ENVIRONMENTAL PHYSIOLOGY SUB-SECTION
1 – PHYSIOLOGIST P – 6
1 – PHYSIOLOGIST P – 4
3 – LTS. OR CAPTS BI-PHYSIOLOGISTS
1 – MEDICAL TECHNICIAN SP – 6
1 – T/3 LAB TECH MEDICAL 858
1 – T/4 LAB TECH MEDICAL 858

3-O 2-EM 1-CIV.

GENERAL PHYSIOLOGY SUB-SECTION
1 – PHYSIOLOGIST P – 5
3 – LTS. OR CAPTS BI-PHYSIOLOGISTS
1 – T/3 LAB TECH MEDICAL 858
1 – T/4 LAB TECH MEDICAL 858

REVISED NOV. 21, 1946

RE-EVALUATION OF PROGRAM

For

MEDICAL DEPARTMENT FIELD RESEARCH LABORATORY

FORT KNOX, KENTUCKY

PART I

GENERAL MISSION AND SCOPE OF LABORATORY

The general mission of the laboratory is to provide, through research, scientific information on physiological problems or on the physiological phases of general projects that have military significance.

The scope of the work of this laboratory, although encompassing work in such basic sciences as physiology, physiological chemistry and biophysics, is controlled to the extent that no matter how basic it is, it will aim at the ultimate objective of providing sound fundamental data that will directly or indirectly be pertinent to applied or clinical research.

It is clearly recognized that urgent applied problems with high military significance demand first priority but it is also contended that any long range program must include problems of a basic nature as well as those of applied nature. It is often necessary in the pursuit of applied problems to develop new basic methods and to delve into certain fundamental problems in order to acquire the "tools" and the basic facts to complete an applied project. This is not research merely for the sake of research, but is definitely needed fundamental research with a specific aim. Keeping in mind the general mission of the laboratory, it is often advisable, particularly during periods when high priority projects are not pressing, to develop fundamental data that may well be of use in future applied projects.

The following broad fields of research activity have been approved for the laboratory (approved by C.G., A.S.F., 31 May 1946):

1. Studies of Body Reactions and Requirements under Varied Environmental and Climatic Conditions, AMRL - 55.

2. Studies of Fatigue in Relation to Military Tasks, AMRL - 56.

3. Studies of Body Measurements as They Affect Physiological Efficiency, AMRL - 54.

4. Studies of Physiological and Psychological Problems of Military Personnel in Relation to His Equipment, Environment and Military Tasks, AMRL - 57.

Recommendation: That these broad projects be retained as indicative of the scope of the work the laboratory is capable of doing, rather than as specific project titles. All project titles should fit into one of these broad fields; for example, the following projects fit into the first broad field mentioned above since they deal with reactions to climate and environment:

1. Cold, Study of Physiological Effects of.

2. High Temperatures, Study of Physiological Effects of.

The following fits into the broad field of body measurements:

Survey of Foot Measurements and Proper Fit of Army Shoes.

The U. S. Army has had combat experience under all climatic conditions except those in extreme cold and basic information on this subject is incomplete and limited in scope.

Recommendation: That the fundamental physiological and biochemical processes involved in the response to cold be investigated thoroughly so as to form a sound basis for the selection of personnel, of equipment, and of training and conditioning measures to be used for operations in extreme cold. It is further recommended that these projects in general be given the highest priority.

A survey of the available current literature indicates that the studies listed in Part II below are needed, in that solutions are not reasonably satisfactory at present. Many of these studies can be worked out in this laboratory in the foreseeable future. The reports of observers participating in field operations, the publication of the results of war research and of research in other countries, the development of new techniques, and information derived from research in associated fields will require, from time to time, modification of the problems listed, and a change in priorities.

Capabilities of the Laboratory Staff: Under the leadership of the present incumbents of the principal staff positions, this laboratory is capable of handling many diversified problems of a physiological nature that will be of interest and value to the Medical Department. Borderline problems that encompass more than physiology can well be handled in part by this laboratory and in toto by cooperation with other laboratories. This laboratory now has the nucleus of a physiological unit that can eventually become an integral part of the proposed Army Medical Research Center.

The fields of interest and the qualifications of the present staff at the Armored Medical Research Laboratory are indicated by the number of original investigations which have been published by the various members on different aspects of physiology as listed below:

Nervous System	
Central	5
Peripheral	27
Blood	7
Heart and Circulation	38
Kidney	28
Digestion	3
Nutrition	24
Metabolism	
Respiratory	36
Intermediary	19
Endocrine- glands	11
Radioactive Isotopes	2
Toxicology and Pharmacology	16
Instrumentation and Methods	26

Recommendation: That this laboratory act as consultant on physiological aspects of other army research. For example, when radioactive isotopes are injected, it is important that the possibility of concentration of the substance to dangerous levels in secretory tissues, such as the kidney, be considered. In the design and testing of new apparatus for the collection of unused data, the relation of control devices and operational procedures to the physiological capabilities of the operator is of great importance. The Armored Medical Research Laboratory is prepared to assist and, in some cases, collaborate in such problems.

The following facilities would assist in the work of AMRL, if made available by AMRDB:

1. Periodic publication and distribution to all agencies of AMRDB of descriptive titles of all current government research projects in the fields of medical science.

2. An AMRDB committee organized during the planning stage of any operation such as Frigid, Frost or Muskox, to coordinate the activities of research and observation teams from the various research laboratories and disseminate timely detailed information on the operation.

Transfer of Current Medical Department Projects (Contracts)

The scope is not included in the titles of the projects listed in the Medical Department Research Program as of 1 August 1946. A number of physiological and biochemical studies which might be included in the scope indicated by these titles could be carried out profitably in this laboratory. It is suggested that the physiological and biochemical aspects of the following contract projects might be transferred to AMRL, or that the staff of AMRL might collaborate in these projects, provided that adequate personnel is available:

a. Contract MD 362, Research in Peripheral Vascular Diseases and Injuries, Emore University. This laboratory has capable personnel experienced in peripheral vascular physiology, and is greatly interested in problems dealing with the peripheral circulation in relation to cold and in animal experiments on the mechanism of production and prevention of arteriosclerosis, vessel spasm, Buerger's disease, emboli, and varicosities.

b. Contract MD 352, Peripheral Nerve Injuries, Johns Hopkins University. This laboratory has experienced personnel capable of conducting basic animal experimentation on the loss of physiological function in injured nerves, and the return of function in regenerating nerves. This laboratory at present does not have access to patients for a clinical investigation of this subject, nor to War Department records for a statistical report on war injuries.

c. Contract MD 363, Investigation of Methods for Testing Nerve Injuries. The staff of AMRL has had experience in the various techniques for stimulating nerve and is competent to investigate methods for testing nerve injuries.

d. Contract NL 346, Frostbite and Immersion Foot, New York Medical College. The staff of AMRL includes investigators who are qualified to investigate this problem in basic terms of (1) thermal equilibrium, (2) peripheral circulation including local reflex responses, (3) capillary permeability and tissue fluid distribution. Animal work on this subject can well be carried on in this laboratory in connection with foot and cold problems now in progress.

e. Contract MD 326, Ability of Soldiers to Work in Humid Heat, University of Michigan. The past work of this laboratory and the special facilities here, make this problem ideal for this laboratory. However, it is felt that "cold" problems should take precedence over "hot" problems at this time.

In addition to the above, this laboratory is in a position to study the physiological aspects of projects dealing with wound ballistics.

PART II

SPECIFIC PROJECTS

The projects are numbered in accordance with the project numbers assigned to the broad fields of research activity approved for this laboratory, 31 May 1946 (see Part I, page 2). The second number refers to the number of the project classed under the broad field. The letters "A," "B," and "C" refer to recommended priority of the project. Each category is defined as follows:

Category A - Short term projects directed at the solution of immediate military problems. The development of essential techniques required for the solution of such problems is also included.

Category B - Long range, extensive projects directed at the solution of immediate military problems. These projects require the development of techniques listed in category A, or the designing and construction of complicated apparatus which is not commercially available. It is proposed that these projects be initiated when indicated by the development of techniques, or when complicated apparatus can be completed. The availability of research personnel and instrument makers will also affect the time work on these projects can be started.

Category C - Short and long range projects indirectly applicable to military problems. These projects may become more important with the development of other phases of research, or with a change in the present estimate of the type of research desired by the Army.

The projects are divided into three groups- I, those now in progress; II, contemplated projects; and III, projects that might well be undertaken by this laboratory. In many cases the objectives stated are broad optimistic long range aims which may never reach fulfillment, but may be viewed as goals toward which the project will be directed. Since projects listed in group III are only indicative of type, specific objectives and scopes have been omitted.

I. Projects now in Progress:

55-1-A, Physical Fitness in Connection with O.Q.M.G. Ration Test No. 4631
(Project completed, report being compiled)

Objective: To compare physical fitness of troops during mountain training receiving the E ration, the 10-in-1, New C, or the A ration.

Scope: Physical fitness was determined by the Harvard Step Test. Preliminary report has been submitted to Test Commander. Detailed report will be submitted in the near future.

55-2-A, Energy Expenditure Studies in Mountain Training (in connection with O.Q.M.G. Test No. 4631) Project completed, report being compiled.

Objectives: To determine energy expenditure of men in mountain training. To make a rough determination of caloric needs of troops under these conditions.

Scope: CO_2 output under various climbing conditions was determined by the use of a modified infra-red gas analyser and by the Douglas-Haldane method. Caloric output was determined from CO_2 figures and a rough caloric balance was calculated.

Preliminary report has been submitted to the Test Commander. Detailed report will be submitted in the near future.

55-3-A, Observations in Alaskan AGF Operations (Frigid and Williwaw)

Objective: To observe and make recommendations that will be of interest to the Medical Department. To make as many field test observations on physiological function under these conditions as possible.

Scope: One civilian scientist and two medical officers are to make the observations and field tests. These three men will act as subjects for most of the tests. Preliminary observations on techniques and portable apparatus are being carried out in the laboratory cold room. Field tests to provide some data on the following are contemplated: Energy expenditure, thermal exchange, water balance and physical efficiency under various conditions in cold climate. The results of observations in the field will indicate new problems and will permit a comparison of the physiological effects of the laboratory cold room with those of the Arctic.

55-4-A, Effects of Hypothermia on Vitamin A and Carotene Levels in Blood and Liver

Objective: In cold environments there is an alteration in fat metabolism. It is believed that Vitamin A may be essential in fat metabolism. What is the role of Vitamin A in resistance to and operation in cold environments?

Scope: Preliminary studies are being carried out on small animals at different hypothermic levels. The concentrations of Vitamin A and carotene in blood and liver, and possibly other tissues, will be related to the resistance of the animal to cold environments.

55-5-A, Tests of Validity of Present Quantitative Measurements of Renal Functions of Renal Blood Flow at Low Environmental Temperatures

Objective: To test accuracy of present methods of study of renal function under various stresses in cold environments. There is some alteration of renal function in cold environments.

Objective: (cont'd.) What are the best methods to study this alteration and what do these alterations mean in the acclimatization of man to cold?

Scope: Preliminary studies are being carried out on animals. Later the techniques will be applied to man in the cold room. Functions studied will be: Rate of urine flow, rate of glomerular filtration, effective renal plasma flow, tubular excretory mass and rates of tubular transfer of solutes.

55-8-A, Development of Techniques for Measurement of Blood Flow and Velocity in Intact Unanesthetized Subjects

Objective: In studies of frostbite, trenchfoot, Raynaud's and Buerger's diseases, as well as acclimatization to cold, it is essential that the rate of blood flow through the area under investigation be determined. No adequate method is available. Studies are being directed toward developing a method for measuring velocity in intact unanesthetized subjects.

Scope: The limitations of the electromagnetic flowmeter, the thermostromuhr and the various methods resting on volume recording devices, including impedence plethysmograph, will be determined and proposed modifications tested. In addition, the possibilities of a polarographic method will be investigated. Dogs are being used in the preliminary studies.

55-11-B, Study of Physiological Changes such as Thermal, Circulatory and Respiratory Responses of Small Animals to Immersion Hypothermia and Exposure to Cold

Objective: To determine relative susceptibility of physiological mechanisms to cold. This analysis will be of value in selection, training, and equipping of personnel for cold operations and will provide a guide for intensive research of the effects of cold on specific physiological mechanisms in man. Information may be derived which will have application in the handling and treatment of casualties from exposure to cold.

Scope: Preliminary studies will be made on rats, later dogs. During immersion physiological responses such as temperature change, oxygen consumption, CO_2 production, total heat loss, survival times, etc., will be followed. Correlate findings with survival times and autopsy findings.

54-1-A, Effect of Non-Support in Plantar Arch of Army Shoes (project completed)

Objective: To provide information relative to need of plantar arch in shoes for marching men.

Scope: Forty-five (45) soldiers marched 13.5 miles daily over varied terrain. The subjective reports of the subjects and the results of daily foot inspections form the basis of the report. Detailed report will be submitted in the near future.

54-2-A, Effect of Low Heel in Army Shoes

Objective: To provide information regarding the effect of low-heeled marching shoes on soldiers' feet.

Scope: Forty-five soldiers fitted with shoes similar to Army Type 3, reversed upper, but with one-half inch spring rubber heels, march 13.5 miles daily over varied terrain. The subjective reports of the subjects and the results of daily foot inspections will form the basis of the report.

54-3-B, Distribution of Somatotypes in RTC Recruits

Objective: To determine the distribution of somatotypes in Fort Knox RTC personnel. Data may be used as a guide in design of clothing and equipment and may constitute a basis for further correlation with military performance and ability.

Scope: Three photographic views in the nude are taken of newly inducted RTC personnel at Fort Knox. These photographs will be analysed in reference to body dimensions and somatotype groupings will be determined.

54-4-B, Cinefluorographic Studies of Shoe-Foot Relationship

Objective: To make cinefluorographic records of the changes in the supporting structure and the soft tissues of the foot and in their relation to the shoe during walking. This technique will provide a picture of the dynamic, functional fit of a shoe designed for walking.

Scope: Cinefluorographic records will be taken at the highest practicable rate of the shod foot during a step. Analysis of these x-ray slow motion pictures will show the fit of standard shoes on different type feet and the fit of experimental type shoes on selected, representative type feet. Results will be correlated with the dynamics of the foot.

54-5-A, Test of Operator Performance with Signal Corps Equipment in Extreme Cold

Objective: To determine the effects of cold and the wearing of Arctic clothing on operator performance with Signal Corps equipment, and to recommend changes in clothing, equipment and/or procedures.

Scope: To evaluate the performance of experienced Signal Corps operators with representative equipment in normal and extreme cold environments with respect to time required for operations, accuracy of adjustments, etc. To recommend and test changes which would be expected to increase operator efficiency in cold environments.

54-6-A, Physiological Considerations in the Use of Plastic Ear Molds for Communications Equipment

Objective: To determine the effect of plastic ear molds on the possibility of injuries to the ear by physical blows, concussion of explosions, loud noises, improper insertion or removal, and wear over a long period of time.

Scope: Individual ear molds will be fitted to a test group of soldiers who will wear them while acting as subjects of other tests. These tests will include a wide range of military activities and environmental temperatures including extreme cold. Men equipped with ear molds and others with standard communication equipment (ear phones) will be subjected to the same noises, concussion from explosives, etc. Possible injuries will be determined by a comparison of audiometric tests in the two groups. An analysis of the dimensions of the individual ear molds will be made to determine the feasibility of at least a semi-universal mold. The range of dimensions of the ear molds of this small group will indicate if a universal mold might be designed from data supplied by a much larger group.

57-2-C, Silica Content of Dust from Tank Ranges (project completed)

Objective: To determine whether the high incidence of respiratory infections in tank personnel might be related to the silica content of dust.

Scope: Ground and airborne samples of dust have been collected, separated into size groups, and analyzed for silica content. Correlations have been worked out. Detailed report will be submitted in the near future.

57-4-C, Determination of Lung Tissue Potential and Its Effect upon Impregnated Silica Particles

Objective: To determine the tissue potential in lungs of intact animals (dogs) and the effect of this potential on very small particles of silica impregnated in the tissue.

Scope: Using a bronchoscope, electrodes are placed in the lung of an anesthetized animal and the potential measured in reference to other parts of the body. Factors which modify the potential are being determined and the potential will be related to changes resulting from the presence of silica particles.

II. Contemplated Projects

At the present time it is contemplated that the following projects, or projects very similar, will be undertaken in the next few years. The starting time will depend upon urgency, available time and facilities.

55-7-A, Study of Subjective Sensations and Loss of Dexterity Produced by Local Cooling

Objective: To determine the effect of cold hands on military performance.

Scope: Skin and deep temperatures of arms and hands exposed to cold will be related to reports of subjective sensations, kinesthesia, tactile discrimination, performance time and accuracy of manual tasks similar to those involved in operating military equipment.

55-8-A, The Effect of Low Temperature on the Rate of Absorption of Drugs Injected Subcutaneously

Objective: Casualties exposed to low temperatures frequently do not respond to repeated injections of morphine because absorption is retarded by poor circulation. When circulation is improved, morphine previously injected over a long period may be quickly absorbed. Deaths have been attributed to this delayed absorption.

Scope: By use of appropriate measuring methods, the rate of absorption of innocuous radioactive isotopes which have been injected subcutaneously will be followed in subjects exposed to cold. The absorption rate will be correlated to skin temperature at time of injection.

55-9-A, The Effect of Anesthetic and Analgesic Drugs on Thermal Equilibrium in Cold Environments

Objective: To determine the most suitable anesthetics and analgesic drugs to use on soldiers exposed to cold environments; for example, battalion aid stations. To select for use in other "cold" experiments, the anesthetic which interferes least with the heat regulating mechanism.

Scope: Experimental animals exposed to such cold conditions that will produce a slow fall in body temperature. Oxygen consumption and body temperature will be determined as a function of exposure time. Comparisons will be made with animals under the effects of various anesthetics in like environmental conditions.

55-10-A, Effect of Local Sweat Suppressive Measures on the Skin Temperature and Comfort of Clothed Men in Cold Environments

Objective: To determine whether local treatment of hands and feet with sweat suppressive agents will increase resistance to cold. If a sufficient effect is produced, the addition of sweat suppressive agents to foot powder can be considered.

Scope: One hand and one foot of men will be treated with aluminum chloride, using the other hand and foot as control. Environmental temperatures will be related to reports of subjective sensations and skin temperatures on treated and untreated sides.

55-12-B, Effect of Hypothermia and of Shivering on Metabolism

Objective: To determine the effect of hypothermia on the production of heat and to evaluate the effectiveness of shivering in maintaining thermal equilibrium in cold environments.

Scope: The heat production, oxygen consumption and carbon-dioxide production will be determined in hypothermic, shivering and non-shivering subjects. The results will give some information to the problem of increased fat metabolism in the cold and show the effectiveness of the shivering mechanism in increasing heat production. Some information on the mechanism for the control of shivering will be sought.

55-13-B, Thermodynamics of Hypothermia

Objective: To measure in subjects exposed to cold environments the sources of heat, the heat capacity, skin temperatures and tissue temperature gradients, and heat loss through radiation, convection and evaporation. This basic information will provide a check on constants now used in thermal problems, and will more accurately quantitate the requirements of clothing for use in extreme cold.

Scope: The heat production will be determined by direct calorimetry. Results will be compared with heat production calculated from oxygen consumption. Heat storage will be calculated. Heat loss will be measured in terms of radiation, convection and evaporation. Thermal gradients will be measured under equilibrium conditions by comparing deep and superficial temperatures. These factors will be studied in normal and extremely cold environments.

55-14-B, Circulatory Changes Resulting from General Hypothermia and Local Cooling of Body Parts

Objective: To determine the changes in cardiac output, circulation time and blood volume produced by hypothermia. To determine the indirect and reflex effects on the general circulation by cooling certain parts of the body. These changes are of significance in the etiology of frostbite and trenchfoot.

Scope: Using animals, the effects of sudden cooling of body parts will be determined on local blood flow, cardiac output and circulation time. In general hypothermia, analysis of the results will indicate whether changes in the systemic circulation is of significance in the development of local circulatory difficulties.

56-16-B, Effect of General Hypothermia and Local Cooling of Body Parts on Kidney Function and Renal Blood Flow

Objective: To determine if the reduction in internal body temperature to the lowest point compatable with complete recovery alters the excretory and secretory activities of the kidney. To determine the extent of effect of local cooling of a body part on the renal circulatory pattern.

Scope: The rates of excretion of various constituents of the blood and of specially administered test substances will be measured. Wherever possible, the substances studied will be measured by the radioactive tracer method. Special attention will be given to the electrolytes due to their importance in body salt and acid-base balances.

56-16-B, Role of Environmental Temperature in the Production of Shock

Objective: To determine the influence of environmental temperature on the development of shock.

Scope: Anesthetized animals will be subjected to a standard trauma under a range of environmental conditions. The time required for the onset, and the development of shock will be related to environmental, skin and internal temperatures.

57-1-B, Effect of Metabolic Stimulants on the Performance of Military Tasks in Cold Environments

Objective: To determine the effect of metabolic stimulants on the ability of soldiers to withstand cold and to perform military tasks with inadequate protection against cold.

Scope: The effect of metabolic stimulants such as thyroid, epinephrine, caffeine and benzedrine on skin temperature, comfort and performance of soldiers will be determined and the value of such agents in cold operations will be assayed.

56-1-B, Circulatory Changes During Exercise, Fatigue and Changes in Posture

Objective: To study changes in blood flow incident to exercising muscle groups to complete fatigue and to study circulatory compensation for changes in posture. Results will supply additional information on fatigue and permit a more accurate estimate of the value of exercise and postural change in the prevention of trench foot and frostbite.

Scope: When techniques are developed for measuring blood flow in specific arteries of normal man, changes in flow to extremities when exercised to fatigue or a change in posture will be determined.

56-2-B, Effect of Exercise, Fatigue and Changes in Posture on Functions of the Kidney and Renal Blood Flow

Objective: To analyze the changes produced in activity of the kidney as influenced by severe exercise, fatigue and long maintained postures.

Scope: Subjects will be exercised to fatigue and others will be placed in unusual postures (such as trapped under an overturned vehicle or cramped overnight in a foxhole). Both excretory and vascular changes of the kidney will be studied.

56-17-C, Study of the Etiology and Prevention of Coronary Insufficiency

Objective: A large number of young men during World War II developed coronary disease. A large percentage of these died with gross coronary intimal lesions. Evidence indicates a functional or organic basis. It is proposed that attempts be made to produce these lesions in experimental animals and that methods of prevention and treatment be investigated.

Scope: Animals will be exposed to conditions known to cause circulatory reactions, such as abnormal dietary components or psychic stimuli. When evidence of coronary insufficiency occurs, the mechanism of production will be studied in detail and causative and preventive factors will be determined. When the disease can be produced experimentally, a study will be made of methods of treating the lesions.

55-18-C, Study of the Etiology and Prevention of Peptic Ulcer

Objective: The incidence of peptic ulcer in military personnel was higher during the recent war than in comparable age groups in civilian life. It is proposed to investigate the causes and prevention of peptic ulcer in animals whose diet is similar to that of man.

Scope: Animals will be exposed to dietary and environmental conditions which predispose to peptic ulcer. Those factors which are active in producing ulcers will be studied in detail and protective diets and other preventive measures will be formulated.

55-28-C, Studies on the Vaso-Depressor Principle in Shock

Objective: To identify the vaso-depressor agent which, according to recent work, may be responsible for irreversible shock. To study methods of inactivating or destroying this agent with the aim of developing a treatment for irreversible shock.

Scope: The vaso-depressor agent which has been demonstrated in the tissues of animals during irreversible shock will be concentrated by biochemical means. The properties and mode of action will be studied. The process of inactivation which has been reported to occur in the liver will be investigated in an effort to isolate or concentrate a material which will inactivate the vaso-depressor agent. The vaso-depressor agent is reported to be antagonized by a vaso-exciter principle produced in the kidney. The vaso-exciter principle will be concentrated, and properties determined. Information concerning the principle causing the condition of shock, a process which destroys this principle, and another which antagonizes its action, should lead to an effective treatment of irreversible shock.

55-29-A, Electrically Heated Blanket for Use in Extreme Cold

Objective: To test feasibility of using electrically heated blankets for casualties.

Scope: Test various commercially made and Air Corps blankets in the laboratory cold room. Determine the power input necessary to keep a man warm at very low temperatures. Determine skin and internal temperatures of men lying under such blankets for extended periods of time in the cold room.

55-30-B, Investigation of the Effects of Hypothermia on Normal Blood Constituents

Objective: To determine both qualitatively and quantitatively the changes that take place in normal blood in the hypothermic state.

Scope: The changes that take place in the blood when an organism is exposed to subnormal temperatures is not clearly understood. Studies on the acid-base balance, oxyhemoglobin dissociation, levels of metabolites of fat, carbohydrate and protein metabolism, and levels of various vitamins will assist in the better understanding of the metabolic changes that occur in hypothermia.

III. List of Problems that Might Well be Undertaken in the Future

This list is indicative of the type of project in which this laboratory is interested:

55-31-C, Effect of Cold on Excitability, Conductivity and Refractory Period of Peripheral Nerve

57-3-C, An Analysis of Water Requirements of Troops in Relation to Wet and Dry Bulb Temperatures

55-19-C, The Physiology of the Renal Syndrome Due to Crushing Injuries

55-20-C, The Acid-Base Balance of the Blood and Activity of the Respiratory Center in Hypothermia

55-21-C, Effect of Varying Tensions of Respiratory Gases on Blood Flow and the Pattern of Circulation

55-22-C, Effect of Cold on Excitability, Time Functions of Response, Maximum Tension and Physical Properties of Skeletal Muscle

55-23-C, Effect of Hyperthermia on Renal Blood Flow and Function

55-24-C, Relation of Quantity and Temperature of Ingested Fluid to Sweat Production

55-25-C, The Effect of Environment on Sensory Perception and Simple Reactions

55-26-C, Role of Afferent Nerve Impulses in the Production of Shock

55-27-C, A Quantitative Comparison of Methods Used to Improve Blood Flow in Treatment of Frostbite and Other Conditions of Reduced Peripheral Blood Flow

54-7-C, Development of Apparatus and Technique for Taking True Normal Speed Cineroentgenograms

54-8-C, Development of a Self-Resolving X-Ray Stereogram

55-33-C, Development and Modification of the Tiselius-Schlieren Type Electrolytic Optical Analyser

PERSONNEL AND FACILITIES

Personnel: After the scope of research has been determined and the means to accomplish it, both in personnel and funds estimated, it is believed to be most desirable that serious consideration be given to the separation of the source of both personnel and funds from bulk allocation to the Medical Dept., or that such personnel and funds be specifically allocated for research purposes.

It is not practical in the fields of research to subject research organizations and projects to repeated changes in scope and means to accomplish their work.

Obviously the economics imposed upon chiefs of technical services, both in funds and personnel, must be apportioned down thru the entire organization under the existing system. Such economies mean in many instances that important projects must be abandoned, even though considerable money and effort may already have been expended upon them.

It is strongly recommended that some system be instituted under the direct control of the Research and Development Board of the War Department General Staff so that the scope of research, personnel and funds to accomplish it remain relatively fixed with a yearly re-evaluation and estimate of funds required, such as is accomplished in all other activities.

It is the considered opinion of the undersigned that the minimum requirement for personnel to accomplish the research program as outlined above is as follows:

Officers - 19
Enlisted - 51
Civilians - 29

In view of the absence of Regular Army enlisted personnel trained and qualified for use as research laboratory technicians, it is believed that a long range training program should be established for selected enlisted personnel. It takes a minimum of six months to train such enlisted personnel even though they possess an excellent educational background in the basic sciences. In the early stages of such a training program, it would be even more desirable that they remain in training for one year. These trained research technicians would then be "at home" in such a laboratory and would be of particular value in forming a nucleus for a trained staff in the proposed Army Medical Research Center in Washington.

It is also believed most desirable that MOS classifications should be established for both officer and enlisted personnel who are qualified in research fields to aid in the assignment of such personnel and to prevent the loss or improper utilization of their special talents thru misassignment. Many ASTP Medical Officers with excellent backgrounds in research training are on duty in the Army. Some of these officers might well consider an Army career if some inducement could be offered which would assure them of continuance in their research fields. It would appear that some public statement of policy on this matter would be of material value.

Facilities: The facilities of this laboratory are inadequate from the standpoint of space.

A report on construction requirements has been forwarded through channels. A copy of report is attached (see Incl. 1).

F. J. KNOBLAUCH
Lt. Colonel, MC
Commanding, AMRL

General Information on the Role of the Armored Medical Research Laboratory in the Procurement of High Caliber Civilian Technical and Professional Personnel for the Laboratory at Fort Knox, Kentucky

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KENTUCKY

SUBJECT: Procurement of High Caliber Civilian Technical and Professional Personnel for the Armored Medical Research Laboratory at Fort Knox, Kentucky

1. Prior to World War II, the United States Army conducted medical research on a very limited scale due to the meagerness of funds appropriated for that purpose. The Medical Department of the United States Army emerged from this war acutely conscious of the handicaps it suffered because of the inadequate pre-war medico-military research.

The demands for answers to military-medical research problems encountered during this war were met by improvisations and the marshalling together of civilian professional and technical personnel from established research centers. See Inclosure #1.

The Medical Department realizes that, in order to meet its responsibilities of instituting measures for the protection of the health of troops and the treatment of the sick and wounded, it must keep fully abreast of advances in the general field of medicine. To accomplish this objective the Surgeon General is prosecuting an aggressive program of Military Medical Research. See Inclosure #2.

2. The Armored Medical Research Laboratory was established during the war and is now reorganized on a permanent basis with a strong financial backing.

This Laboratory was initially activated with the mission of studying and solving physiological problems arising from service with armored vehicles. This limited mission was then broadened to cover physiological and psychological problems of military personnel in general, with special reference to equipment, environment and military tasks. See Inclosure #3.

The future scope of research by this Laboratory will encompass personnel and equipment of all branches of the service and not just armored troops. It will deal with comprehensive physiological and psychological problems incidental to the inter-relationship between man, his equipment, his environment, disease and the military tasks assigned to him. Over 90% of the projects completed, originated in the Laboratory and were not directed by higher authority.

3. Attention is invited to the organizational chart which shows the majority of key positions headed up by civilian technicians and scientists. These are permanent positions, whereas the military personnel will change from time to time. See Inclosure #4.

4. A Consultant Staff is being organized. This staff will include the top men in this country in their respective technical and scientific fields. These men will be called upon for advice when complicated problems arise in connection with the work here.

5. It is the interest of this Laboratory to maintain and encourage the outside contacts of its staff with leading men and research centers in their respective fields. The publication of results obtained here is not only permitted, but is definitely encouraged. Arrangements are also being made with nearby universities to permit contact with teaching staffs and conferences of interest.

It is believed that positions in this Laboratory offer real opportunity for research at good salaries. When the contemplated Army Medical Research and Graduate Training Center is established the Armored Medical Research Laboratory will probably serve as a research field station as an integral part of the Center. There will be an interchange of personnel between the Center and this Laboratory dependent upon current problems under investigation.

While the emphasis is placed upon teamwork in research as much latitude as possible will be given to individual experimentation independent of formal projects to further work on degrees, to attend scientific meetings, etc.

6. The Medical Department desires to employ fully qualified civilian technical and professional research personnel for the positions indicated in Inclosure #6. Applicants will be interviewed prior to final employment either by:

The Associate Director of Research
Armored Medical Research Laboratory
Fort Knox, Kentucky

or

The Commanding Officer
Armored Medical Research Laboratory
Fort Knox, Kentucky

7. References: Attached inclosures.

a. Inclosure #1 - Past History of Research Medicine in the United States Army.

b. Inclosure #2 - Present and Future Military Medical Research Program for the United States Army.

c. Inclosure #3 - History of the Armored Medical Research Laboratory at Fort Knox, Kentucky (with photographs attached).

d. Inclosure #4 - Tentative Organizational and Functional Charts of the Armored Medical Research Laboratory, Fort Knox, Kentucky.

e. Inclosure #5 - Existing positional vacancies on the staff of the Armored Medical Research Laboratory to be filled by employment of Civilian Technical and Professional Personnel.

f. Inclosure #6 - Addressees to contact for further details.

F. J. Knoblauch

F. J. KNOBLAUCH
Lt. Colonel MC, USA
Commanding

6 Incls.

#1 - Past History of Research Medicine in USA
#2 - Present and Future Military Medical Research Program for USA, incl. charts: (1) Army Med Res and Grad Teaching Center (2) Organization Chart
#3 - History of the AMRL
#4 - T/O incl. 4 T/O Charts
#5 - Positional Civilian Vacancies
#6 - List of addressees to contact

PAST HISTORY OF RESEARCH MEDICINE IN U. S. ARMY

In the interval between the two big wars, the Medical Department of the Army had almost no facilities for medical research. This was due to the fact that Congress made only minimal appropriations. In consequence, the Medical Department entered into the second World War with an insufficient background of research-accomplishment in the field of military medicine. The Surgeon General realized this and in 1939 active preparations were taken to secure the aid of qualified civilians through the Division of Medical Sciences, National Research Council. The Council assembled committees of outstanding physicians and medical sciences: These made studies and recommendations embodying professional advice on medico-military problems in 1940. A real start in the right direction occurred in 1941 when, by Executive Order of the President, the Office of Scientific Research and Development was established. Through this agency real cooperation between the Army Medical Department and civilian medical institutions was effected. The investigations sponsored as joint undertakings between the armed services and the civilian groups were widely dispersed through the various fields of medicine.

The following military medical research groups existed or were established and functioned during the War in addition to the Office of Research and Development (OSRD) (for general fields of function, see Inclosure No. 2).

a. Board for Study of Epidemiological Diseases - In the office of The Surgeon General.

b. Malaria Study Unit

c. Army Industrial Hygiene Laboratory

d. Memphis X-Ray Laboratory

e. Climatic Research Laboratory - (Quartermaster Department)

f. Medical Nutrition Laboratory

g. Army Medical School

h. Army Institute of Pathology

i. Aero-Medical Research Laboratory

j. School of Aviation Medicine

k. Medical Research Laboratory - (Chemical Warfare)

l. Carlisle Medical Equipment Laboratory

m. Armored Medical Research Laboratory

It is apparent that military medical problems posed by the military forces were met by such improvisations as: the enlisting of aid from civilian medical research centers and groups and by contractures obtaining knowledge from them; the establishment of new military research centers and expanding of existing ones; the establishment of the Office of Scientific Research and Development by the President as a War Measure to coordinate all medical research labor - all of these measures bore fruit. However, all of these were hurried improvisations and only partially answered certain problems.

Consequently, this lesson learned, The Surgeon General of the Army is determined to now pursue and prosecute an aggressive program for military medical research. See Inclosure No. 2.

PRESENT AND FUTURE MILITARY MEDICAL RESEARCH

PROGRAM FOR THE U. S. ARMY

The present organization of medical research in the U. S. Army is as follows: The entire facilities for medical research are headed up by the Army Medical Research and Development Board located at the office of The Surgeon General and composed of the chiefs of divisions of that office. This board determines and enunciates all general policies to be carried out by Army Research and Development installations. Directly under this Board is the Army Medical Research and Development Division of the Office of The Surgeon General. The President of the Board is also the Chief of this Division. This Division is divided into two branches: the Medical Development Branch and the Medical Research Branch. These branches prepare and implement in detail the general policies enunciated by the Board; the development branch deals only with individual items of medical equipment, defines military characteristics for desired items and forwards these for development of the item; the Medical Research Branch prepares and implements the details for all medical research matters enunciated as general policies by the Board. The Medical Research Branch supervises and has control over all Army Medical Research Laboratories and installations scattered over the country. These are indicated below, along with fields of work in general each carries out.

Name of Unit	General Functions
(1) Board for Study of Epidemiological Diseases (Office of Surgeon General)	Studies for control and treatment of all communicable diseases; work is carried out at Laboratory at Fort Bragg, N.C.
(2) Army Industrial Hygiene Laboratory (Edgewood Arsenal, Md.)	Investigates industrial hygiene problems of all Army-operated plants; gas analyses and toxicological problems.
(3) Malaria Study Unit (Panama)	Conducts research on all aspects of malaria; prevention, treatment, etc.; evaluates anti-malarial drugs.
(4) Memphis X-Ray Laboratory (Memphis, Tenn.)	Conducts research in x-ray diagnosis and therapy; develops and evaluates new techniques.
(5) Medical Nutrition Laboratory (Chicago, Ill.)	Conducts investigations of the adequacy of various diets under varying climatic conditions and physical activity; studies diets in relation to various diseases.
(6) Army Medical School (Washington, D. C.)	Investigations under all branches of medicine; produces vaccines and serum for the Army; research in blood and blood substitutes.

Incl. #2

(7)	Army Institute of Pathology (Washington, D. C.)	Serves as a consultative diagnostic pathology center for entire Army; Army Medical Museum is part of it.
(8)	Carlisle Medical Equipment Lab. (Carlisle, Pa.)	Initiates and develops new items of field medical equipment.
(9)	Armored Medical Research Lab. (Fort Knox, Ky.)	Conducts wide variation of physiological problems dealing with the inter-relation between man, disease, environment, his equipment and his tasks.

Other military medical research units with which there is close collaboration are:

(1) Climatic Research Lab. (Philadelphia, Pa.; Quartermaster Corps Unit)

(2) Aero-Medical Research Lab. (Wright Field; Air Corps Unit)

(3) School of Aviation Medicine (Randolph Field, Texas; Air Corps Unit)

(4) Medical Research Lab. (Edgewood Arsenal, Md.; Chemical Warfare Unit)

All of the findings of these research units are channeled through the Division of Medical Research and Development Division. When proper, this Division takes action to implement the results of the investigative work and translate it into the improvement of equipment or techniques.

The future medical research program, in addition to the continued activities of the above research installations, calls for the construction and establishment of the Army Medical Research and Graduate Training Center described below:

Army Medical Research and Graduate Training Center
(Proposed)

The Surgeon General of the Army has voiced the following objectives for the Medical Department's Research and Development Program.

(1) To keep fully abreast of advances in the general field of medicine.

(2) To prosecute an aggressive program of research in those specific fields or portions of fields of peculiar interest to the military medical service.

(3) To insure constant advancement of the qualities of medical service.

The Surgeon General recognizes the following requirements for the attainment of the above objectives:

(1) To centralize facilities, personnel and related activities into a research and development center in a location where there is ready access to other research groups in the same field.

(2) Ready access to the amenities of normal living (suitable quarters, schools, hospitals, business, recreation facilities, etc.)

In recommending the Center, the following characteristics were considered:

(1) It must include facilities for research in all fields of science pertaining to medicine, including facilities to carry on research in the field.

(2) It must provide an adequate opportunity for its professional personnel, military and civilian, to participate in clinical research and graduate teaching in the many varied specialties.

(3) Its location must afford the closest possible contact between its personnel and the personnel of other Federal and civilian research and teaching groups and centers.

(4) It must afford accessible living and transportation facilities which will attract and hold the highest type of personnel, military and civilian.

Predicated on the above objectives and characteristics, The Surgeon General has submitted to the War Department for approval, a plan for the construction of the Army Medical Research and Graduate Training Center. It has been recommended that this Center be located in Forest Glen, Md., on the outskirts of Washington, D. C. The Office of The Surgeon General has no reasonable doubts that this project will be approved as such or in modified form. It estimates this approval will be forthcoming immediately and that construction may begin this coming summer. It is estimated that it will take approximately three years for complete construction.

The organization and arrangement of the Center will be as shown in the organization chart and sketch of the physical plant attached.

The activities, in general, of the comprising institutes of the Center are as follows:

Army Institute of Pathology: (Already in existence in Washington, D. C.), furnishes a consultation service for the diagnosis of pathologic tissue for entire Army; conducts investigation and research on diseases of medico-military importance; supplies instruction in pathological anatomy to Medical Department officers. Tissue specimen from all autopsies and unusual surgical operations from all Army medical installations are sent to this institute for study.

Army Institute of Research Medicine and Dentistry: Research will be carried on in the fields shown in the attached chart.

Environmental Physiology: Encompasses studies of effects on military personnel imposed by equipment, military tasks, extremes of temperatures, etc.

Microbiology: Includes study of bacterial and parasitic diseases.

Biochemistry: Studies fundamental to many problems of internal medicine, microbiology, toxicology, etc.

Nutrition: Nutritional studies of all types.

Industrial Hygiene: Includes not only problems of Army-operated production plants, but also specific toxicological problems of weapons and equipment.

Psychiatry: Selection of personnel for military service, methods for influence of attitudes and behavior, war neuroses, etc.

Internal Medicine, Chemotherapy: Development and evaluation of new drugs, methods, techniques, etc.

Anthropology: Perfects designs of clothing and equipment best suited to the maintenance of physical efficiency of military personnel.

Army Institute of Research Surgery, Cancer, and Radiation Therapy: Studies involving shock, healing of wounds and burns, nerve regeneration, plastic surgery; wound ballistics; field of radiation including atomic energy, x-ray and radium.

'Sternberg Pavillion': 1000 bed general hospital; all patients to be available for clinical observation and conferences. In addition 100-200 beds will be set aside specifically for research use.

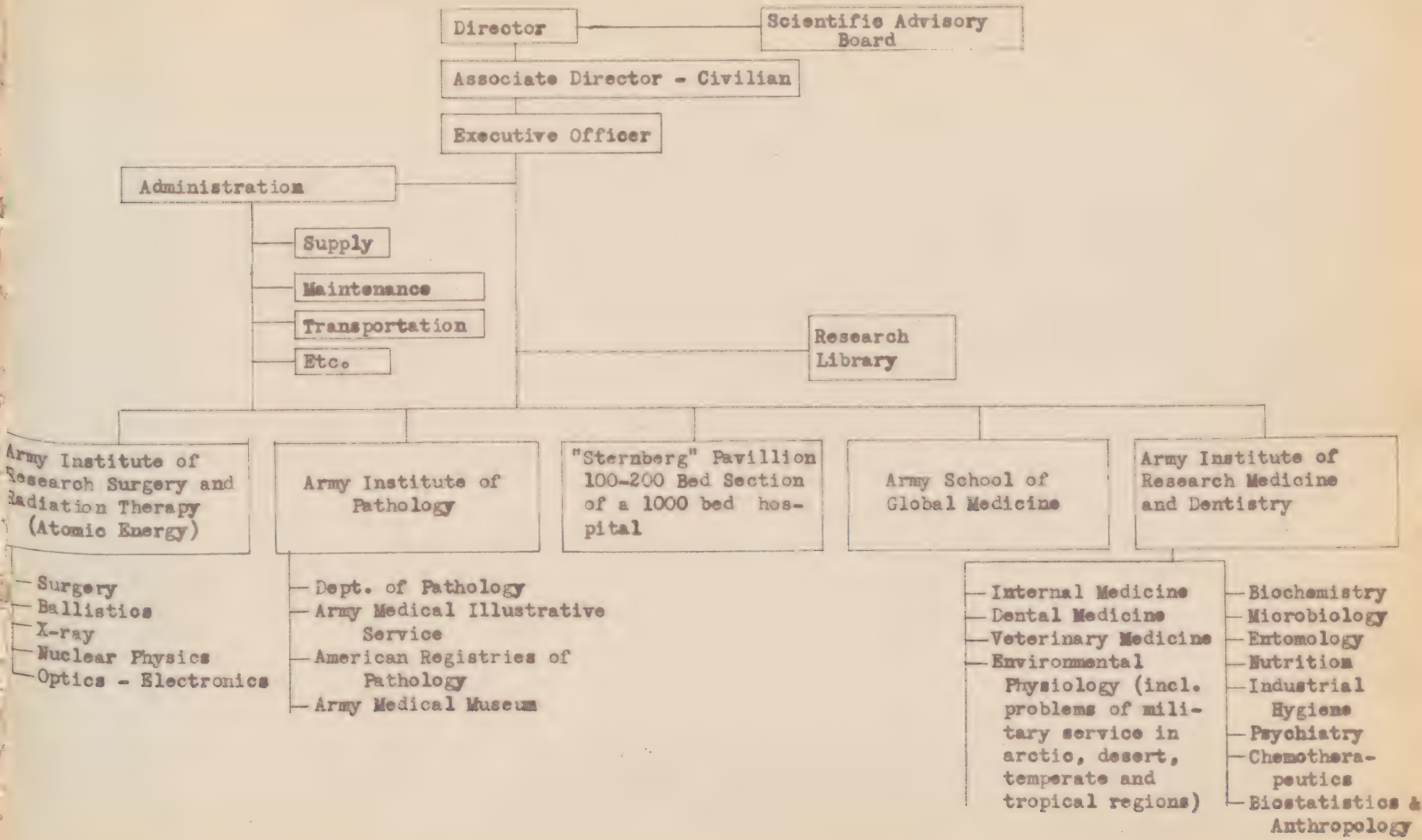
Army School of Global Medicine: Conducts courses of post-graduate instruction to medical officers in all fields of medicine and surgery. The staffs of the various institutes will serve as the teaching staff of the Global School.

Administration and Facilities: Center will be administered from one common point. A library of approximately 50,000 books will be established.

It is apparent that the above program for medical research in the Army is aggressive, expansive, and comprehensive. With the various types of Army research installations now operating (such as the Armored Medical Research Laboratory) and the establishment of the Army Medical Research and Graduate Training Center, it is believed there will not be any other medical research center or group, military or civilian, that will compare with it.

ORGANIZATION CHART

Army Medical Research and Graduate Training Center (Proposed)



Incl. #2

SHOPPING CENTER
QM STORES ETC.

REPAIR-UTILITIES
HEATING PLANT, SALVAGE
STORAGE WAREHOUSES
FIRE DEPT ETC.

RECREATION
DRILL FIELD
OFFICERS CLUB
THEATRE

PARKING
ENLISTED PERSONNEL QTS

N.C.O. QTS.

STERNBERG TEACHING PAVILION

PARKING
NURSES TECHNICIANS QTS.

PARKING

ARMY INST

ARMY INST

N.C.O. QTS.

JUNIOR OFFICERS QTS

PARKING

ARMY INSTITUTE OF PATHOLOGY

RESEARCH LIBRARY
ADMIN BLDG

ARMY SCHOOL OF GLOBAL MEDICINE

PARKING

JUNIOR OFFICERS QTS

SENIOR OFFICERS QTS.

(PROPOSED — SKETCH)

SENIOR OFFICERS QTS.

DEPUTY DIV.

EXEC OFF

DIRECTOR

ARMY MEDICAL RESEARCH AND GRADUATE TEACHING CENTER

INCL NO 2

HISTORICAL REPORT

OF

ARMORED MEDICAL RESEARCH LABORATORY

Incl. #5 (Incl. photos 1 - 14)

ARMORED MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

SPMEA 319.1 3 October 1945

SUBJECT: Historical Report

TO: The Surgeon General
U. S. Army
Washington 25, D. C.
ATTN: Occupational Health Division

1. In compliance with letter, The Surgeon General's Office, Washington, D. C., dated 18 August 1945, the following historical account is submitted:

2. INTRODUCTION:

a. The Armored Force Medical Research Laboratory was established at Fort Knox, Kentucky, in September 1942.

b. Since the beginning of the Armored Force in 1940, it has been apparent that armored personnel are subject to stresses, physical and mental, calling for unusual performance. This raises questions of physical fitness and adaptability of armored personnel to perform their required tasks in the environmental extremes encountered in combat. While these influences and considerations are of greatest importance in relation to armored personnel, they are not unique to that group, and investigation of them would of necessity be of benefit to other arms.

c. The recognition of the existence of the problem led to consideration of solutions. It was apparent from the outset that the scope and precise nature of the problems needed to be defined, and that investigation and research were required. There existed no agency adequate for this purpose. Accordingly, early in 1941 the Armored Force referred the matter of need for research facilities to the Division of Preventive Medicine, the Surgeon General's Office, and to the National Research Council. In September 1941, a group representing the Committee on Industrial Medicine of the Committee on Medical Research, and their consultants visited Fort Knox to study the problem in the field. A report of their findings and investigations was presented for consideration to the Chief of the Armored Force and to The Surgeon General. This was followed in December 1941 by an official request from the Commanding General, Armored Force, for the establishment of a laboratory as recommended by the Committee on Medical Research. Official directive for the construction of the Laboratory was published 3 February 1942. (See first annual Historical Report, AFMRL, 11 February 1943).

d. Construction was initiated 18 April 1942 and building completed and accepted on 1 September 1942. The cost of the unit, approximately $220,000.00, provided for the building without equipment or supplies. (See first annual Historical Report AFMRL).

e. Beginning in April 1942 steps were taken by The Surgeon General's Office to procure suitable personnel, and in June 1942 the Office of Scientific Research and Development sent a member of the Laboratory staff to England to study operating problems and for consultation with the staff of the Armored Fighting Vehicle Physiological Laboratory which had been in operation there for about two years.

f. In the meantime, the staff of the Laboratory, which had been recruited from a number of civilian sources, had been enlarged to eight investigators. Work was actively in progress in temporary quarters at Fort Knox during the summer of 1942.

g. In August 1942 five members of the staff were sent to the Desert Training Center, Camp Young, Indio, California, to set up temporary laboratory facilities and carry out studies in the desert. By the time the laboratory was ready for occupancy much work had already been done and basic data collected on fatigue of tank crews, high temperatures in tanks, and dust exposure of men in armored vehicles. Of more importance, the results of the desert expedition made possible planning of the climatic research programs.

h. In mid-November 1942 permanent laboratory equipment and furniture were installed and much makeshift and borrowed equipment were dispensed with.

i. In August 1942 formal request for activation of the Laboratory was made by the Commanding General, Armored Force, and activation was accomplished 1 September 1942.

3. FUNCTION AND ORGANIZATION:

a. The function of the Laboratory was delineated by the Commanding General, Armored Force, on 23 September 1942 and it was specified that the Laboratory would conduct research and experimentation on physiological problems of practical significance to the Armored Force.

b. In essence, the purpose of this Laboratory is to study the soldier in relation to his duties, as required in the Armored Force. The aim is to obtain the basic data on selection and training of personnel and performance of equipment, from which conclusions may be drawn which will enable the individual soldier to perform his duties with maximum obtainable efficiency for the longest possible time, and to determine these limits imposed upon personnel so that they may be used to the best advantage by commanders and tacticians. The Laboratory is a part of an enormous program, both civilian and military, which is taking a profound interest in the primary unit of the Army, namely the individual soldier. Nearly the whole of the investigative group in American medicine is studying, for the first time in its history, the healthy man and his capacities. This effort in all probability is the beginning of a new chapter in medical and

military history in which the healthy and efficient man and "how to keep him that way" is going to play a larger role than the saving of life in the ill or wounded men. The maximum mental and physical capacities of soldiers are being determined and their jobs and equipment are being planned around the soldier, rather than vice versa.

c. Since the meaning of the word medicine is much broadened by such an approach, this Laboratory was organized with the view of combining the knowledge of many sciences in an effort to solve the problems confronting the soldier. The Armored Medical Research Laboratory is divided into seven sections (Administration, Medicine, Physiology, Chemistry, Ventilation, Physics and Engineering), under the direction and supervision of a medical officer who is commanding officer and director of research activities. Each section is headed by a highly trained and thoroughly experienced investigator, whose interest in his own field has been directed toward the application of that field to the problems of human health and sustained productive capacity. Within each section specialists in the important branches of that science have been added, each of which has a staff of technicians trained by him to carry out investigative work. The organization has been further supported by liaison with The Surgeon General, the National Research Council, National Defense Research Committee, the Navy, the Air Corps, and related investigative groups in Canada and England. Such contacts are essential to a well-rounded effort which does not seriously overlap investigations of other groups and when fully developed prevents much loss of time and unnecessary duplication.

d. Armored Medical Research Laboratory was operated under control and supervision of the Commanding General, Army Ground Forces, Washington, D. C., from September 1942 until 3 February 1944. On that date, pursuant to W. D. Circular 98, 1944, the Armored Force Medical Research Laboratory was transferred from the jurisdiction of the Army Ground Forces to that of the Army Service Forces, and was designated a Class IV Installation under the control of the Occupational Health Division, Office of The Surgeon General, Washington, D. C.

4. MILITARY AND CIVILIAN PERSONNEL:

The Laboratory functions under an allotment of 18 officers, 43 enlisted men, and 15 civilian personnel. The ranks and grades of the personnel are shown in the attached chart of the Table of Organization. Civilian personnel have been utilized where it has been difficult to obtain specialized assistance from military sources. (Inclosure #1).

5. PROJECTS UNDERTAKEN:

a. General: Problems for investigation by Armored Medical Research Laboratory were set up as approved projects on 24 September 1942 by authority of the Commanding General, Armored Force, Fort Knox, Kentucky, as follows:

(1) Cold Weather Operations

(2) High Temperatures in Tanks

(3) Toxic Gases in Armored Vehicles

(4) Dust Exposure in Armored Vehicles

(5) Crew Fatigue Research

(6) Vision in Tanks

(7) Night Vision from Tanks

(8) Methods of Preselection of Armored Force Personnel

(9) Anthropometric Measurements of Armored Force Personnel

b. For ease in administration within the Laboratory and allocation of responsibility, a number of sub-projects were set up under these main headings and subsequently other authorized projects were added, as shown in Inclosure #2. These indicate the manner in which work on the major problems was undertaken.

c. Work has been conducted on some phases of all the major projects. Many of them were susceptible to prompt solution and firm recommendations were made: others have been only partially completed, and in this sense, are continuing projects and should receive further consideration in the future program of research and development. Certain of the original sub-projects were found to be of little interest and were not pursued. These, indicated by (*) in Inclosure #2, were officially cancelled.

d. The work of the Laboratory was more in the nature of immediate application of known physical and physiological principles than in basic research. Immediate solutions were required and these had to be found, sometimes in the absence of an adequate body of basic knowledge and, consequently with less than completely satisfactory results. The experiences of the Laboratory in this respect constitute strong argument for future peacetime research into the basic factors which influence the effectiveness of the soldier so that when the military need arises again this fundamental information will be available for the solution of new problems.

6. SUMMARY OF REPORTS SUBMITTED:

A complete list of Laboratory reports follows. These are divided into groups according to main subject and the significance of each group is commented upon.

a. STUDIES IN COLD WEATHER OPERATIONS:

(1) Study of the Heat Retaining Capacities of Insulated Jugs, Project 1-20, 9 December 1942.

(2) Heat Retaining Capacities of Insulated Jugs, Project 1-20, 18 February 1944 and 9 December 1942.

(3) The Adequacy of Armored Force Winter Clothing, Project 1-1, 1-4, 1-5, 1-6, 18 January 1943.

(4) Test of Electrically Heated Gloves, Project 1-21, 20 March 1943.

(5) Test of Raincoat with Parka Hood, Poncho, Rainshirt, Knee Length Raincoat, Synthetic Resin, NAD Tent Poncho, Sectional, Project 1-23, 29 April 1943.

(6) Outfit Combat, M-1943, Experimental Test No. OQMG-140, Project 1-22, 3 May 1943.

(7) Test of Clothing, Battle, Four-Zone (OQMG-214) Cold and Arctic Zone Issues, Project 11, 30 September 1943.

(8) Test of the Adequacy and Range of Use of Winter Clothing and Study of the Methods for Selection of Men for Cold Weather Operations, Project 1-1, 1-18, 10 April 1944.

(9) Influence of Cold Upon the Efficiency of Personnel, Project 1-11, 25 May 1944.

(10) Immobilized Air (OQMG Test Number 57-IV), Project 20-4, 24 May 1944. Report of Observations on Maneuvers of 76th Infantry Division, Watersmeet, Michigan, 20 March 1944.

(11) The Insulation Provided by Windbreaks, Project 20-2, 1 June 1944.

(12) Protective Value of Arctic Issue Clothing, Project 1-1, 2 June 1944.

(13) The Effect of Leakage from Closures upon Thermal Protection (OQMG Test Number 57 1-A), Project 20-1, 14 June 1944.

(14) Analysis of Position of Armored Force Personnel in Respect to Winter Protection with Recommendations for use and/or Design of Suitable Equipment and Food. Project 1-10, 11 July 1944.

(15) Study of the Physiological Effects of Cold, Project 1-19, 16 June 1945.

Studies followed two major trends: (1) the physiological reactions of men to cold and (2) the evaluation of clothing designed for cold weather operations. The high incidence of Trench Foot experienced during the war increased our interest in the study of provoking mechanisms. Close collaboration with OQMG in the field of clothing investigation was constantly maintained and in many instances specific projects were undertaken at the request of that office. In addition, the Laboratory maintained close liaison with other investigative groups engaged in allied studies. In the winter of 1943 a member of the staff took part in the winter operations study at Shilo Camp in Canada and

during the following winter another staff member was attached to the group.

Evaluation of cold weather clothing was always limited owing to the lack of an adequate body of data on the behavior of men at subnormal temperatures since little basic work had been done prior to the war. Investigation had, therefore, to be directed simultaneously toward basic problems on the one hand and the application of basic principles to clothing design and testing on the other. Under the war emergency this was not always satisfactory.

b. STUDIES IN OPERATIONS AT HIGH TEMPERATURES:

(1) Evaporative Ambulance Cooler, Project 2-8, 9 October 1942.

(2) Report on Results of Desert Field Study, Project 2-8, 20 October 1942.

(3) Water and Salt Requirements for Desert Operations, Project 2-6, 12 November 1942.

(4) Study of Men in Simulated Desert Heat, Project 2-11, 12, 13, 17, 3 April 1943.

(5) Test of Individual Crew Conditioning System, Project 2-28, 27 April 1943.

(6) Study of Methods of Reducing the Heat Load in Tanks, Project 2-24, 11 May 1943.

(7) Test of Truck, 3/4 Ton, Refrigerated Ambulance, Project 2-29, 15 May 1943.

(8) Determination of Water and Salt Requirements for Desert Operations, Project 2-6, 20 May 1943.

(9) Test of Truck, 3/4 Ton, Improved Insulated Ambulance, Project 10, 12 June 1943.

(10) Determination of the Amount of Heat Transmitted to the Fighting Compartment of Tanks under Field Conditions. Project 2-22, 17 August 1943.

(11) Studies of Men in Simulated Jungle (Humid) Heat, Project 2-7, 11, 13, 15, 17, 19, 18 October 1943.

(12) Memorandum on Comparative Absorption of Solar Radiation by O. D. Griptred Paint Relative to Standard O. D. Paint on Tanks, 9 November 1943.

(13) Test of the Adequacy and Ranges of Use of Clothing for Jungle Operations and Effects of Impregnated and Impervious Clothing Upon the Efficiency of Personnel, Project 2-3, 2-18, dated 24 November 1943.

(14) Effect of Insulation of Transmission and Final Drive Upon the Heat Load Within Tanks, Project 16, 4 February 1944.

(15) Determination of the Amount of Heat Transmitted to the Fighting Compartment of Tanks Under Field Conditions, Project 2-22, 8 March 1944.

(16) The Upper Limits of Environmental Heat and Humidity tolerated by Acclimatized, Normal, Young Men Working in Hot Environments. Project 2-11, 13, 17, 2 October 1944.

The physiological reactions of men in the heat were under continuous study in the Laboratory, these studies being directed primarily toward the phenomenon of acclimatization, water and salt requirements and determination of the limits of tolerance to heat and humidity. The basic data thus obtained were directly applicable to practical field problems and formed the basis for recommendations for handling of troops in the field. However, lack of access to the combat theatres by staff members particularly in the tropics, seriously limited the usefulness of the Laboratory program.

Studies of tropical clothing and personal equipment and the extra heat load imposed by impregnated protective clothing of various types were also carried out. The sources and magnitude of heat exposure in armored vehicles was studied in the Laboratory and field and recommendations for improvements in tank ventilation and other control measures formulated. These studies demonstrated the importance of tropical and other hot environments in determining the effectiveness of combat soldiers and illustrate very clearly the need for an understanding of physiological capacities and limitations of soldiers in the planning and conduct of military operations.

c. INVESTIGATION OF TOXIC GAS HAZARDS IN TANKS:

(1) Carbon Monoxide Hazard from Auxiliary Generators in Tanks, Project 3-12, 20 December 1942.

(2) Control of Gun Fumes in M-4 Series Medium Tanks, Project 3-1, 3-5, 15 February 1943.

(3) Report on Gun Fume Hazard from 37mm Gun in M-5 Light Tank, Project 3-2, 18 February 1943.

(4) Carbon Monoxide Hazard from Auxiliary Generators in Tanks, Project 3-12, 2 April 1943.

(5) Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in the M-7 Tank, Project 3-13, 8 April 1943.

(6) Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M-5 Series, Project 3-2, 26 April 1943.

(7) Determination of Basic Ventilation Characteristics of Tanks of the M-4 Series and Determination of Basic Ventilation Characteristics of Tanks of the M-5 Series, Project 3-4, 3-6, 26 April 1943.

(8) Determination of the Characteristics and Effects upon the Crew of Gun Fumes from Firing of the Weapons in the M-4A4E1 Tank, Project 3-15, 29 April 1943.

(9) Control of Gun Fumes in M-4 Series Medium Tanks by Positive-Pressure Ventilation, Project 3-1, 3-5, 22 July 1943.

(10) Evaluation of the Gun Fume Hazard in the LVT A-1, Project 34, dated 1 May 1944.

(11) Carbon Monoxide Hazard from Exhaust Gases in Tanks that are in Tow, Project 28, 11 May 1944.

(12) Test of Carbon Monoxide Hazard from Engine in Light Tank, M-24, T-7, 19 April 1945.

(13) NDRC Infra-Red Gas Analyzer for Carbon Monoxide, T-9, 18 May 1945.

The control of gun fumes in tanks was a continuing problem of interest and importance in the Laboratory program. Improvements in tank ventilation for the elimination of this hazard were developed and recommended each new vehicle. Unfortunately the Laboratory did not always have the opportunity to study vehicles in early pilot model so that compromise measures had to be taken in improving vehicles in production. Inadequate control of gun fumes in tanks in certain combat areas resulted in definite loss of effectiveness of the tank and its crew, thus, demonstrating the importance of initial physiological analysis of a weapon as well as evaluation of its mechanical and tactical features.

d. PROTECTION OF TANK CREWS AGAINST CHEMICAL WARFARE AGENTS:

(1) Ventilation Requirements for Gas-Proofing the M-5 Tank, Project 3-9, 24 December 1942.

(2) Partial Report on Ventilation Requirements for Gas-Proofing Tanks of the M-4 Series, Project 3-9, 1 March 1943.

(3) Determination of Ventilation Requirements for Gas-Proofing Tanks of the M-4 Series, Project 3-9, 23 June 1943.

(4) Protection of Personnel in Tanks Against Toxic Agents, Project 17, 7 March 1944.

(5) Report of Activities and Observations on "Field Test of Ventilated Facepiece System of Tank Protection," Project CWS D4.1-11, conducted at Ordnance Desert Proving Grounds, Camp Seeley, AWC, 7 March 1944.

The problem of protection of tank crews against chemical warfare agents engaged the attention of the Laboratory from the beginning and a series of studies were conducted to determine the characteristics and limitations of

the several protective means: A complete self-protecting tank, individual supply of clean air to each crew member and the use of standard gas mask. Each had its advantages and limitations. In these studies the Laboratory worked closely with CWS and Ordnance. Because of the fortunate absence of chemical attack during the war no actual field experience was obtained and no final recommendations were made. The problem requires further study since the potential effectiveness of chemical warfare against tanks is very real.

e. DUST:

(1) Test of Expendable Dust Respirator, E-5, Test 3, 3 January 1945.

(2) Determination of Dust-Loads and Characteristics of Dusts Encountered in Operation of Armored Vehicles, Project 4-1, 10 September 1945.

The dust generated by armored vehicles operating in dry country is a great nuisance and causes some eye irritation. It has not been regarded as a major problem by combat units and has, therefore, not received the same attention as other more important problems. Studies of dust concentrations, particle size and mineralogical composition indicate that a negligible silicosis hazard exists among armored personnel. An inexpensive expendable respirator was designed and adopted. Future design of tank ventilation should include means for reducing dust providing it can be accomplished at acceptable cost.

f. RESEARCH IN TANK CREW FATIGUE:

(1) Adequate Head Room in Tanks, Project 5-1, 27 November 1942.

(2) Seat Design for M-4 Tanks, Project 5-12, 5 March 1943.

(3) Memorandum on Size and Shape Requirements for Tank Hatchways, 6 March 1943.

(4) Driver Fatigue in Bendix Power Control No. 908 as Compared with Standard M-4A2 Medium Tank, Project 5-32, 5 May 1943.

(5) Comparison of Tests of Physical Fitness, Project 5-29, 10 March 1944.

(6) Final Report on Appraisal of Kind and Degree of Physical Effort Required of Tank Crews in Relation to Fatigue, Project 5-13, 24 March 1945.

(7) Crew Fatigue Research, Study of Fatigue in Men on Long Marches, Project 5-20, 9 May 1944.

(8) Letter Report on Emergency Tank Escape Hatches, 15 September 1944

(9) Seats for Truck (4 x 4) Ton (Peep), Project 5-12, 5 February 1945.

Undertakings under this project heading fell into two categories, physiological and engineering. Physiological studies included measurements of work rates required in the performance of various crew activities, studies in physical fitness and its evaluation and the effects of environmental conditions upon fitness and working capacity of armored personnel. Engineering studies included determination of design requirements for tank seats, hatchways, ammunition stowage, optimum positioning and operation of controls, elimination of unnecessary obstruction and the like. Measurements of work rates showed that weight and size of round and accessability of ammunition must be carefully considered in tank design. Satisfactory progress was made in seat design. Working directly with Ordnance and seat manufacturers, the Laboratory recommendations were fully adopted. Improvements in size and operation of hatchways resulted for the work of the Laboratory, thus contributing markedly to the satisfaction of tank crews who are naturally sensitive to ease of escape from tanks. Many other mechanical improvements came from the combined physiologic and engineering analysis of armored vehicles, many of which were informally considered with the Armored Board and Ordnance and do not appear in reports.

g. PRESELECTION:

(1) Preselection Tests, Project 8, First Partial Report, 20 January 1943.

(2) Preselection Tests, Project 8, Second Partial Report, 22 April 1944.

(3) Preselection Tests, Project 8, Final Report, 17 March 1945.

Preselection of armored personnel in relation to the physical and physiological requirements of tank crews and nature of activities was not widely employed in this war. The Laboratory developed certain basic principles for formulating a preselection policy which, it is to be hoped, will receive future consideration. It must be recognized that a tank is a highly complex mechanical weapon of great capacity and for its most effective use unusual demands are placed upon the crew. These require the best possible scheme of preselection as well as training. Experience in other services, notably the Air Force and Navy, has demonstrated the value of preselection. Adoption of a program of preselection and specialized training, however, requires practical working arrangement which will insure the distribution of men into the combat units for which they were selected and trained.

h. ANTHROPOMETRIC STUDIES:

(1) Anthropometric Measurements, 1 February 1943.

(2) Memorandum on Analysis of Fit of H13/CRS Headset Under ML Helmet, 30 October 1943.

(3) Memorandum on Analysis of Fit of R30 Receiver Unit. 30 October 1943.

It was early demonstrated that basic data on the size characteristics of the soldier population were necessary to a proper design of tanks and personal equipment. These data were collected and distributed to Ordnance, Signal and CWS for use in design of equipment pertaining to the armored force.

i. FIRE CONTROL AND VISION:

(1) Visual Requirements, Characteristics and Limitations of Present Visual Devices in Tanks and Means for Improving Sighting Telescopes and Periscopes, 23 January 1943.

(2) Visual Requirements for Spotting, Project 6-1, 6-6, 20 February 1943.

(3) Placement and Mounting of Sights in Tanks, 9 June 1943.

(4) Fire Control for Large, High Velocity Tank Guns, 29 September 1943.

(5) Vision in Tanks, Project 6-2, 6-4, 28 December 1943.

(6) Lateral Offset Sight, Project 6-4, 27 September 1943.

(7) Telescopic Sights T-106-E1 and M-71-F in Comparison with Other Tank Sights, Project 6-2, 6-4, 23 February 1944.

(8) Driver's Vision in Landing Vehicle Tractor, 9 March 1944.

(9) Military Characteristics of Spectacle Type Binoculars, Project 40, 30 May 1944.

(10) Vision in Tanks, Eye Cups, Head Rests and Head Clearances, 6 September 1944.

(11) Improvement in Driver's Vision in Tanks, 7 September 1944.

(12) Test of Telescopes T122 and T123, Project 47, 7 September 1944.

(13) Report on Periscopic Sight T8 and Mount T105, Project 48, 22 September 1944.

(14) Parallelogram Mounting of Reflex Sight for 50 Cal. Anti-Aircraft Machine Gun, Project 6-15, 14 October 1944.

(15) The Advantages of Using Binoculars for Night Seeing, 24 March 1945.

(16) Study of Errors in Range Estimation with the Unaided Eye, 30 April 1945.

(17) Military Characteristics and Design of Observation Telescopes, Project 38, 1 May 1945.

The essential function of a tank is to provide mobile fire power with sufficient armor protection to permit the weapon to operate in areas denied to other weapons and troops. Being a direct fire weapon, it requires highly accurate fire control facilities and in order to utilize the protection of its armor fully, the crew must be able to see without exposing themselves. Adequate facilities for fire control and general vision, therefore, constitute primary requirements of tank design. The work of the Laboratory with respect to these problems was far-reaching. New fire control instruments and vision devices were designed and tested, and the Physics section was in constant consultation with Armored Center, Armored Board and Ordnance in connection with these problems. The elementary and limited instruments and devices first provided were replaced by facilities commensurate with the demands of the weapon. Basic concepts were formulated and substituted as design principles for uncoordinated development of instruments for separate vehicles. The formal reports on these problems represent only a fraction of the work accomplished. Direct consultation was, perhaps, of greater importance. At first glance, problems of fire control may appear to be far-removed from the interest of the Armored Medical Research Laboratory. On the contrary, the recognition of the importance of the man himself in determining design requirements, as well as the development of systematic principles of fire control were major contributions of the Laboratory.

j. NIGHT VISION:

(1) The Use of Red Light for Maintaining Drak Adaptation in Tanks, Project 7-2, 7-3, 5 December 1942.

(2) Interior Lighting of M-4 Tanks, Project 7-2, 7-3, 25 February 1943.

(3) Determination of the Lighting Requirements for Various Tasks of Tank Crews, Project 7-1, 5 August 1943.

(4) Comparison and Evaluation of Field and Laboratory Methods of Measuring Night Seeing Ability of Ground Troops, Project 7-8, 1 May 1944.

(5) A Program for the Improvement of the Night-Seeing Ability of Ground Troops, Project 7-5, 31 May 1944.

The peculiar characteristics and limitations of night vision play a basic part in determining the success of night military operations. There was greater recognition of this fact in the recent hostilities than previously. The Laboratory work in this connection was directed at the outset toward the problems of the Armored Force, but expanded in its latter stages to include the whole problem of Ground Forces. A system of classification and selection of personnel in terms of night visual capacity was developed and a training program formulated in cooperation with the Armored School. The basic approach to the development of new tactics based upon known capacities to see at night was worked out, providing a foundation upon which to construct such tactics in the future.

k. GUNNERY ERRORS:

(1) Determination of the Sources, Magnitude and Costs of Gunnery Errors, Project 21, 24 May 1944.

(2) Determination of the Sources, Magnitude and Costs of Gunnery Errors, Project 21, 16 June 1944.

(3) Study of Errors in Field Artillery Practice (First Partial Report), Project 37, 18 September 1944.

(4) Studies of Errors in Field Artillery Practice (Second Partial Report), Project 37, 22 March 1945.

(5) Studies of Errors in Field Artillery Practice (Fourth Partial Report), Project 37, 28 March 1945.

(6) Studies of Errors in Field Artillery Practice (Third Partial Report), 6 April 1945.

(7) Study of Errors in Field Artillery Practice (Final Report), Project 37, 13 June 1945.

Two major studies were undertaken under this main heading -- an evaluation of moving tank fire, using the gyrostabilizer and a determination of the sources and magnitude of human errors in artillery fire. In the first case, it was demonstrated that the present gyrostabilizer is deficient in design and that the reaction time of the gunner limits the maximum possible accuracy of moving fire while using this device. In the second study it was found that many correctable sources of error existed in artillery procedures, particularly in the design of instrument scales. New instruments designed and constructed by the Laboratory were shown to reduce frequency of errors to a marked degree. Of greater importance than the detailed findings of these studies was the demonstration that errors in gunnery are capable of systematic study and quantitative measurement and that the information derived therefrom leads to improvements not only in design of instruments and procedures, but also in training. During the war valuable time was employed in training to overcome deficiencies in gunnery which could have been eliminated thereby releasing more time for training in essential features of gunnery. Because of the long training period available in peace time, this needless loss of time was not emphasized and little had been done to correct deficiencies or, indeed, to reduce gunnery technics to their basic principle.

l. PROTECTION OF TANK CREWS AGAINST FIRES:

(1) Measurement of Temperatures During Ammunition Fires in Tanks, 2 March 1943.

(2) Methods of Protection Against Flash Burns (Restricted), Project No. 14, 13 November 1943.

(3) Test of Compounds - Fire Resisting, for Field Treatment of Clothing - OCMG-253, Project No. 27C, 13 March 1944.

(4) Fire Resisting Compounds for Clothing, Project 27, 13 March 1944.

(5) Supplemental Report on Time-Temperature Relationships which Produce Hot Air Burns of Human Skin, Project 14, 20 July 1944.

(6) Test of Flameproofed Clothing - First Partial Report. Physiologic Effects of Wearing Flameproofed Clothing in Hot Environments, Project T-5, 17 July 1945.

(7) Test of Flameproofed Clothing - Second Partial Report, Effects of Wearing Flameproofed Clothing in Hot Environments, Project T-5, 21 July 1945.

(8) Test of Flameproofed Clothing - Third Partial Report, Effects of Wearing Flameproofed Clothing in Hot Environments, Project T-5, 31 July 1945.

Armored vehicles burn relatively easily and the hazard from tank fires was a serious one in combat. Personal protective measures including flash burn preventive cream and fire resistant clothing were investigated. More basic studies have been conducted, designed to determine the primary causes of tank fires, the role of ammunition stowage, reference of attacking weapon and means of controlling tank fires.

m. NOISE AND BLAST:

(1) Effect of Exposure to Tank Noise Upon Hearing Acuity of Tank Crews, Project 5-8, 20 January 1943.

(2) Test of Acousti-Guard (Ear Protective Device) Project 12, 5 November 1943.

(3) Investigation of Ear Plugs for Protection Against Gun Blast, Project 26, 5 August 1944.

Audiograms obtained on a group of gunnery instructors indicated that many experienced considerable loss in hearing following various periods of exposure to gun blast. Repeated tests on subjects of the same group, examined after several months of freedom from blast exposure, indicated little improvement in hearing loss while those who continued exposure showed definite signs of greater hearing loss. Several modern ear protectors were tested for protection against gun blast and were found to be effective. It was recommended that ear protectors be worn by personnel repeatedly exposed to gun blast.

n. PHYSIOLOGICAL ANALYSIS OF NEW VEHICLES:

(1) Physiological Characteristics of M-4E5 Tank, 27 November 1943.

(2) Physiological Characteristics of Blitz III, Tank, 8 December 1943.

(3) Physiological Characteristics of M-4E6 Tank (With 76 mm Gun), 16 December 1943.

(4) Physiological Characteristics of the T-25E1-T-26E1 Tank, Project 41, 19 July 1944.

(5) Physiological and Operational Characteristics of T-25E1, Project 41, 19 July 1944.

(6) Physiological and Operational Characteristics of Tank T-25E1, Project 41, 8 November 1944.

(7) Physiological and Operational Characteristics of an M-24 Tank, Project 44, 8 November 1944.

(8) Physiological and Operational Characteristics of M-24, Project 44, 8 November 1944.

(9) Physiological and Operational Characteristics of T-26E3, Project 45, 3 February 1945, First Partial Report.

(10) The Physiological Work Rates of the Driver and Loader in the Tank T-26E3 in Relation to Fatigue and Efficiency of Performance, Project 45, 19 June 1945.

The work of the Laboratory on the design and operational requirements of armored vehicles resulted in the formulation of basic physiological specifications which should be met. As new tanks were developed they were studied by the Laboratory in relation to these specifications and recommendations were made for the correction of noted deficiencies. When studies were made on early mock-ups and pilot models many of the recommendations were adopted. In certain cases, however, the vehicle came to the Laboratory too late for basic changes to be made or, at best, recommendations were only partially carried out. Experience has clearly indicated that in tank design all primary requirements must be considered simultaneously at the outset and proper provisions made for each. Since changes in design of a given feature almost invariably affect others it is difficult if not impossible to effect such changes after the basic design has been fixed. Physiological requirements are as important as mechanical or tactical requirements. These statements argue for physiological analysis of armored vehicles at the earliest stages of design.

O. RATIONS:

(1) Test of the Adequacy of K-2 Ration in the Desert, Project 2-5, 22 October 1942.

(2) A critique of Army Rations: Acceptability and Dietary Requirements, Project 1-7, 1-15, 2-5, 2-14, 10 April 1944.

(3) Test of Acceptability and Adequacy of U. S. Army, C, K, 10-in-1 and Canadian Army Mess Tin Rations, Project 30, 22 November 1944.

(4) Numerical Requirements for Statistically Valid Results in Field Test of Acceptability of Rations, Project 30, 24 March 1945.

(5) Nutrition Survey in Pacific Theatre of Operations, 22 August 1945.

A comprehensive field study of emergency rations was initiated because of reported inadequacies from theatres, reports of Canadian winter trials and the introduction of many new untested components. A study of ration preferences and dislikes, consumption and waste was carried out on a battalion of troops undergoing vigorous training in the fields. Studies of physical fitness, medical and biochemical status, rifle firing and officers' appraisal of test subjects were carried out in detail. Recommendations for specific deletions and additions, change in basis of issue and use of fresh rations resulted in great improvement in proper utilization of rations. This study was supplemented by a survey of the nutritional status of troops in the various Pacific areas which revealed that food supply, quality and preparation were adequate and that no nutritional deficiencies existed.

p. DESIGN AND FIT OF ARMY SHOES:

(1) The Design and Fit of Army Shoes, Project T-10, 12 June 1945.

Preliminary studies have shown that the design of present Army shoes is not altogether in accordance with shape and size of feet. It was also found that procedures for fitting soldiers' feet are not satisfactory. The resulting situation contributes in no small measure to foot disabilities. Studies indicate that marked improvement can be made with respect to this very important military problem.

q. TEST OF FIELD PACKS:

(1) Test of Harness, Man, M-1944, Project T-8, 6 March 1945.

(2) Test of Suspenders, Pack, Field, Cargo and Combat, Type 4, Project T-1, 14 April 1945.

In conjunction with OCMG, tests were conducted on an improved field pack and harness. By evaluating mechanical stress of component parts of both the harness and pack suspension an improved design was developed and submitted in the above reports.

r. STUDY IN ATABRINE THERAPY:

(1) Investigation of the Effects of Activity and Environment of Atabrine Therapy, Project No. 18, 23 December 1943.

The study was conducted at the request of The Surgeon General, the purpose of the test being to determine certain basic relationships between dosage amounts and schedules, and the concentration of atabrine produced in the blood plasma. Rather precise relationships were demonstrated for the group mean behavior of a large number of subjects. Individual variability within the group was great. This study showed clearly that both group mean plasma concentration and variability within the group had definite and predictable relationship to the dosage.

s. STUDIES IN WATER PURIFICATION:

(1) Bursoline Treated Water. Project 50. The Physiological Effects of Ingestion of Large Quantities, 26 May 1945.

An extensive and comprehensive laboratory investigation was made on the water purification agent "Bursoline" in which a limited group of test subjects were examined for a seven week period in the Laboratory hot room. During this time working personnel were subjected to tropical heat and high daily water requirements while test concentrations of Bursoline were applied to all drinking water. No toxic effects were encountered and it was recommended that Bursoline be considered safe for use as a water purification agent.

9. PROGRESS REPORTS:

a. Project Reports are submitted to those listed in Inclosure 3.

b. Semi-monthly reports are submitted to the Occupational Health Division, Office of The Surgeon General, Washington 25, D. C. on the 10th and 26th of each month.

c. Detailed monthly progress reports are submitted to those listed in Inclosure 4.

d. Annual reports are submitted to the Surgeon General's Office.

10. FIELD STUDIES:

a. Studies were conducted during Desert Maneuvers, summer 1942, at Desert Training Center, Camp Young, Indio, California.

b. Field test of combat rations were conducted in Pike National Forest on battalion of infantry men in summer of 1944.

c. Studies were conducted on sources and magnitude of artillery errors in summer of 1944.

d. Operational studies were made on men wearing gas-protective equipment in tanks in semi-tropical areas at Camp Polk, La., for the purpose of determining the extent of heat load entailed in summer of 1944.

e. Field studies were conducted involving joint operations with

Service Boards and the Armored School on AGF Secret Project "SPHINX" carried out in part at Fort Knox, Kentucky, in summer of 1945.

f. Studies of tank problems in combat were made in the European Theatre of Operations during March and April 1945.

g. Nutrition Surveys were made of Pacific Ocean Areas and Southwest Pacific Areas, April to June 1945.

h. Studies were made in Southwest Pacific Areas, June to September 1945, "Requirements of Tank Design and Operation in Relation to Effectivness of Armored Personnel."

11. CONSULTATIONS:

Owing to the favorable location of the Laboratory at Fort Knox together with the Headquarters of the Armored Force, Board, School and Replacement Training Center, the staff was in close contact with line officers and field units. This resulted in continuous emphasis upon the practical field problems and made possible the most direct application of Laboratory studies to the solution of these problems. As a result, it may be said that day to day consultation with members of the using arm and the continuous demonstration of the value of systematic approach to the solution of problems was more valuable than the formal reports submitted. This continuous consultation culminated in the active participation of the staff in the preparation of the "Equipment Board Report" for future development of armored equipment which made possible a final summary of the main objectives of the Laboratory program.

William B. Bean

WILLIAM B. BEAN
Major, Medical Corps
Commanding

2 Incls.
Incl. #1 - T/O - 18 Sep 45
Incl. #2 - List of Projects

ARMORED MEDICAL RESEARCH LABORATORY

ORGANIZATIONAL CHART

20 - O 14 EM 40 CIV

COMMANDING OFFICER
- 1 - COLONEL MC
- 1 - CLERK STENOGRAPHER CAF -

5 - O 10 - EM 20 - CIV

EXECUTIVE OFFICER
- 1 LT COLONEL MC

ASSOCIATE DIRECTOR
(DIRECTOR OF RESEARCH)
- 1 - CLERK STENOGRAPHER

ADMINISTRATIVE BRANCH
- 1 CAPTAIN MAC

2 - O 1 - EM 10 - CIV

ENGINEERING BRANCH
- 1 - ENGINEER, GENERAL (CHIEF) P 6
- 1 CAPT ENGINEER
- 1 - 1ST LT ENGINEER
- 1 ENGINEER UTILITIES P 3
- 1 - INSTRUMENT MAKER SP 8
- 1 ENGINEERING AID SP 6
- 1 - CARPENTER UNGRADED 15
- 1 - TVSGT MASTER MECHANIC (342)
- 2 - GUARDS CPC 4
- 2 - JANITORS CPC 3

LIAISON - FIELD OBSERVER BRANCH
- 2 - MAJORS MC

CLINICAL MEDICAL RESEARCH
- 1 - CHIEF RESEARCH PHYSICIAN P - 8
- 1 MAJ MC (ASSST RESEARCH PHY)
- 1 - CLERK STENOGRAPHER CAF - 4

STATISTICS SECTION
- 1 - STATISTICIAN
- 2 - STATISTICAL CLERKS

1 - O 4 - EM

MEDICAL DETACHMENT
- 1 - CAPTAIN MAC
- 14 - ENLISTED MEN

PERSONNEL - RECORDS STENOGRAPHIC SECTION
- 1 - M/SGT CHIEF CLERK (502)
- 1 - S/SGT ADMINISTRATION NCO (502)
- 1 - T/4 CLERK M CENTER (667)
- 4 - CLERK STENOGRAPHER CAF - 4
- 2 - CLERK STENOGRAPHER CAF - 3

2 - O 1 - CIV

PSYCHOLOGICAL WARFARE SECTION
- 1 - MAJ MC PSYCHIATRIST
- 1 - 1ST LT OR CAPT MC PSYCHIATRIST
- 1 - PSYCHOLOGIST P - 3

2 - O 2 - EM

BIOCHEMISTRY SECTION
- 1 CHIEF BIOCHEMIST
- 1 - BIOCHEMIST
- 1 - CAPT SNC BIOCHEMIST
- 1 1ST LT MAC OR SNC BIOCHEMIST
- 1 SCIENTIFIC AID (CHEMIST)
- 1 T/SGT LAB TECHNICIAN
- 1 - T/3 LAB TECHNICIAN

PHYSIOLOGY SECTION
- 1 CHIEF MEDICAL PHYSIOLOGIST P 7
- 1 MAJOR MC PHYSIOLOGIST

BIOPHYSICS SECTION
- 1 CHIEF PHYSICIST
- 1 PHYSICAL SCIENCE AID SP - 6
- 1 - CAPT ORD (PHYSICIST)
- 1 - 1ST LT BI (PHYSICIST)

FIELD TESTING
TRANSPORTATION - MAINTENANCE
- 1 - CAPTAIN BI
- 1 - M/SGT FOREMAN AUTO REPAIR SHOP (343)
- 2 - T/3 MECHANIC
- 1 - T/4 MECHANIC
- 1 - T/5 MECHANIC

ARCHIVES - LIBRARY SECTION
- 1 - CHIEF LIBRARY CLERK SP 7
- 1 - CLERK STENOGRAPHER CAF 3

PROPERTY AND SUPPLY SECTION
- 1 PURCHASING CLERK CAF 5
- 1 STOCK CLERK CAF 4
- 1 T/4 STOCK CLERK (834)

ENVIRONMENTAL PHYSIOLOGICAL
- 1 PHYSIOLOGIST
- 1 CAPT BI (PHYSIOLOGIST)
- 1 1ST LT BI (PHYSIOLOGIST)
- 1 T/SGT LABORATORY TECH

GENERAL PHYSIOLOGY SECTION
- 1 CHIEF ANTHROPOLOGIST P - 5
- 1 - LT OR CAPT SNC PHYSIOLOGIST
- 1 1ST LT SNC PHYSIOLOGIST
- 1 MEDICAL TECHNICIAN
- 1 T/3 LABORATORY TECHNICIAN (BNR

LIST OF PROJECTS UNDERTAKEN BY

ARMORED MEDICAL RESEARCH LABORATORY

COLD WEATHER OPERATIONS -- PROJECT NO. 1

Sub-Project	Title
1-1	Test of the Adequacy and Ranges of Use of Winter Combat Clothing.
1-2	Test of the Adequacy and Ranges of Use of Winter Sleeping Issues.
1-3	Test of the Adequacy and Ranges of Use of Winter Shelters.
1-4	Test of the Adequacy and Ranges of Use of Winter Gloves and Hand Warmers,
1-5	Test of the Adequacy and Ranges of Use of Winter Face and Head Protectors.
1-6	Test of the Adequacy and Ranges of Use of Winter Foot Coverings.
1-7	Test of Adequacy of all Combat Zone Rations Intended for Use in Sub-zero Climates.
1-8	Report on Results of Field Study and Liaison with Winter Operations Groups.
1-9	Report on Results of Field Study and Liaison with Mountain Board.
1-10	Analysis of Position of Armored Force Personnel in Respect to Winter Protection with Recommendations for Use and/or Design of Suitable Equipment and Food.
1-11	Influence of Cold Upon Efficiency of Personnel.
1-12	Study of the Effects of Wetting Upon the Efficiency of Winter Clothing.
1-13	Study of Properties of Winter Clothing a. Permeability to Air. b. Transparency to Radiation. c. Relation of Weight to Warmth. d. Relation of Bulk to Weight and Warmth.
1-14	Study of Methods of Attaining and Maintaining Acclimatization to Cold.
1-15	Study of the Total and Specific Dietary Requirements for Cold Weather.

Incl. #2

* - Project Dropped.

*	1-16	Study of Methods for Proper First Aid Care of Incipient and Fully Developed Frost Bite.
	1-17	Test of Effects of Various Stimulants.
	1-18	Study of Methods of Selection of Men for Cold Weather Operations.
	1-19	Study of the Physiologic Effects of Cold.
	1-20	Study of the Heat-Retaining Capacity of Insulated Jugs.
	1-21	Test of Electrically Heated Gloves.
	1-22	Outfit Combat, M-1943, Experimental, Test No. OQMC-140.
	1-23	Test of Raincoat with Parka Hood, Poncho, Rainshirt, Knee Length Raincoat, Synthetic Resin, NAD Tent Poncho, Sectional.

OPERATIONS AT HIGH TEMPERATURES IN TANKS --PROJECT NO. 2

Sub-Project	Title
2-1	Test of the Adequacy and Ranges of Use of Clothing for Desert Operations.
2-2	Determination of the Clothing and Sleeping Equipment Best Suited for Desert Operations.
2-3	Test of the Adequacy and Ranges of Use of Clothing for Jungle Operations.
2-4	Determination of the Clothing and Sleeping Equipment Best Suited for Jungle Operations.
2-5	Test of Adequacy of all Combat Zone Rations Intended for Use in Operations at High Temperatures.
2-6	Determination of Water and Salt Requirements for Desert Operations.
2-7	Determination of Water and Salt Requirements for Jungle Operations.
2-8	Report on Results of Field Study and Liaison with Desert Warfare Board.
2-9	Report on Results of Field Study and Liaison with Tropical Board.
2-10	Analysis of Position of Armored Force Personnel in Respect to Operations at High Temperatures with Recommendation for Use and/or Design of Suitable Equipment and Food.
2-11	Influence of High Temperatures Upon the Efficiency of Personnel.
2-12	Study of Methods of Attaining and Maintaining Acclimatization to High Temperatures.

	2-13	Effect of Training Upon the Efficiency of Performance at High Temperature.
	2-14	Study of the Total and Specific Dietary Requirements for Operations at High Temperatures.
	2-15	Study of the Effects of Drugs and Accessory Food Factors on Efficiency of Personnel at High Temperatures.
	2-16	Study of Methods of Selection of Men for Operations at High Temperatures.
	2-17	Study of the Physiologic Effects of High Temperatures.
	2-18	Effects of Impregnated and Impervious Clothing Upon Efficiency of Personnel at High Temperatures.
	2-19	Study of Efficiency of Performance and Rate of Deterioration Under Conditions of Water Limitation.
	2-20	Study of Methods of Ventilating Suits Proved Impractical for Continuous Wear.
*	2-21	Study of Properties of Clothing for Hot Weather Operations.
	2-22	Determination of the Amount of Heat Transmitted to the Fighting Compartment of Tanks under Field Conditions.
	2-23	Determination of the Amount of Heat Transmitted to the Fighting Compartment of Tanks by the Transmission and Final Drive.
*	2-24	Study of Methods of Reducing the Heat Load in Tanks.
*	2-25	Determination of the Optimum Amount and Distribution of Ventilation Within the Fighting Compartment.
*	2-26	Evaluation of the Practical Value of Evaporative Cooling as a Means of Improving Comfort in Tanks.
*	2-27	Determination of the Refrigeration Load in Tanks and the Size, Weight and Power Requirements of Refrigeration Systems.
	2-28	Test of Individual Crew Conditioning System
	2-29	Test of Truck, 3/4 Ton, Refrigerated Ambulance.

TOXIC GASES IN ARMORED VEHICLES — PROJECT NO. 3

Sub-Project	Title
3-1	Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M-4 Series.

3-2	Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M-5 Series.
3-3	Determination of the Characteristics and Effects Upon the Crew of Gases Arising from the Operation of Engines in Armored Vehicles.
3-4	Determination of the Basic Ventilation Characteristics of Tanks of the M-4 Series.
3-5	Correlation of Basic Ventilation Data with Gun Fume Studies and Development of an Effective Design of Improved Ventilation for the Control of Gun Fumes in M-4 Tanks.
3-6	Determination of the Basic Ventilation Characteristics of Tanks of the M-5 Series.
3-7	Correlation of Basic Ventilation Data with Gun Fume Studies and Development of an Effective Design of Improved Ventilation for the control of Gun Fumes in M-5 Tanks.
3-8	Measurement of the Quantity of Toxic Gases Entering the Crew Compartment of Tanks following Discharge of a Single Round of Various Types of Ammunition.
3-9	Determination of Ventilation Requirements for Gas-proofing Tanks.
* 3-10	Study of the Amount and Composition of Vapors Released into Tanks from the Transmission and Final Drive.
3-11	Determination of the Ease and Speed of Donning Protective Clothing.
3-12	Carbon Monoxide Hazard from Auxiliary Generators in Tanks.
3-13	Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in the M-7 Tank.
3-15	Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in the M-4A4E1 Tank.

DUST EXPOSURE IN ARMORED VEHICLES -- PROJECT NO. 4

Sub-Project	Title
4-1	Determination of Dust Loads and Characteristics of Dusts Encountered in the Operation of Armored Vehicles.
4-2	Investigation of the Value of Deflectors in Reducing the Amount of Dust Exposure in Armored Vehicles.
*4-3	Development of a Simple Type of Throw-Away Dust Respirator.

4-4	Determination of the Design Requirements of Air Cleaners for the Control of Dust in Tanks.
* 4-5	Testing of Commercial Types of Air Cleaners for Control of Dust in Tanks.
4-6	Determination of Practical Standards of Permissible Dustiness for Tank Fighting Compartments.

CREW FATIGUE RESEARCH -- PROJECT NO. 5

Sub-Project	Title
5-1	Study of the Relation Between the Actual Sitting Height of Men and Existing Headroom in Tanks.
* 5-2	Recording and Analysis of Noise Produced by Armored Vehicles.
5-3	Effect of Noise Upon Efficiency of Personnel.
5-4	Physiological Effects of Noise.
5-5	Study of the Course and Nature of Temporary Deafness Caused by Tank Noise.
5-6	Study of Course and Nature of Temporary Deafness Caused by Firing from Tanks.
5-7	Habituation to Tank Noise.
* 5-8	Estimation of the Practical Significance of Tank Noise.
* 5-9	Characteristics of Driving Controls in Relation to Efficiency of Use and Crew Fatigue.
5-10	Characteristics of Turret Controls in Relation to Efficiency of Use and Crew Fatigue.
5-11	Determination of Physical Characteristics and Range Variability in Armored Force Personnel.
5-12	Seating Design and Placing in Relation to Fatigue.
5-13	Appraisal of Kind and Degree of Physical Effort Required of Tank Crews in Relation to Fatigue.
5-14	Study of Optimal Positioning of Visual Devices.
* 5-15	Characteristics of Vibrations in Tanks.
* 5-16	Effects of Vibration in Tanks Upon the Use of Tank Controls and Efficiency of Crew.

*	5-17	Study of Interfering Protrusions on Tanks.
*	5-18	Study of Design and Location of Padding in Tanks.
	5-19	Survey of Tank Accidents and Their Causes in Relation to Tank Structure.
*	5-20	Study of Schedules, Duration and Discipline of Rest Periods for Tank Crews on Long Marches.
	5-21	Measurement of Energy Expenditure of Personnel in Armored Vehicles.
	5-22	Influence of Vibration Upon the Development of Fatigue.
	5-23	Effects of Drugs and Dietary Supplements Upon the Development of Fatigue.
	5-24	Determination of the Total and Specific Dietary Requirements for Varying Degrees of Physical Labor.
	5-25	Measurement of the Efficiency of Performance and Rate of Development of Fatigue when on Emergency Rations.
	5-26	Study of the Relationship of Body Temperature to Efficiency of Performance and the Development of Fatigue.
*	5-27	Relationship of Neurocirculatory Asthenia to Fatigue.
	5-28	The Effect of Varying Concentrations of Carbon Monoxide on Efficiency and Fatigue in Tank Crews.
	5-29	Development of Tests to Evaluate the Physical Fitness of Men.
	5-30	Determination of the Changes in the Physical Fitness of New Selectees Throughout the Period of Basic Training.
*	5-31	Development of Skill Coordination Tests for Drivers, Gunners, and Loaders in Tanks.
	5-32	Bendix Power Control Tank - Driver Fatigue.

VISION IN TANKS — PROJECT NO. 6

Sub-Project	Title
6-1	Determination of the Visual Requirements for Various Tasks in Armored Vehicles (Spotting, Gunnery, Driving, etc.)
6-2	Study of the Characteristics and Limitations of Present Visual Devices in Tanks.
6-3	Study of Means for Improving Periscopes.
6-4	Study of Means for Improving Sighting Telescopes.

6-5 Investigation of Short-base Range Finders.

6-6 Investigation of Periscopic Binocular Spotters.

6-7 Investigation of All-around Periscopic Visual Devices.

* 6-8 Study of Methods for Protection of Optical Surfaces from Moisture and Mechanical Damage.

* 6-9 Study of Methods for Reducing Reflection from Exposed Optical Surfaces.

* 6-10 Investigation of Methods for Tank-to-Tank Communication.

* 6-11 Investigation of Methods for Detection of the Enemy.

* 6-12 Investigation of Methods for Discovery of Camouflage of Tank Crews.

* 6-13 Investigation of Range-Finding by Short-Wave Methods.

* 6-14 Investigation of Methods of Range-Findings by Modulation of Infra-Red Rays.

* 6-15 Study and Development of New Instruments for Indirect Fire Control.

* 6-16 Investigation of Methods for Selection of Personnel for Range-Finding.

* 6-17 Development of Instruments for Testing, Scoring, and Training Range-Finder Operations.

NIGHT VISION FROM TANKS — PROJECT NO. 7

7-1 Determination of the Lighting Requirements for Various Tasks of Tank Crews

7-2 Determination of the Intensity, Distribution and Type of Illumination in Tanks Least Disturbing to Dark Adaptation.

7-3 Investigation of Methods of Improving Night Vision in Tank Crews by the Use of Eye Appliances.

* 7-4 Determination of Role of Diet and Food Supplements in Improving Night Vision.

7-5 Establishment of Criteria and Methods for the Selection of Crews for the Night Operations.

7-6 Study of the Relationship between Visual and General Fatigue.

7-7 Investigation of the Effects of Gun Fumes on Night Vision and Dark Adaptation.

7-8 Comparison and Evaluation of Field and Laboratory Methods of Measuring Night Visual Acuity

7-9 Study of Light Transmission through Instruments at Night and its Range of Visibility.

7-10 Study of Brilliance Values and Contrasts of Sky and Countryside at Low Levels of Illumination.

7-11 Investigation of Recognition Threshold at Low Light Levels with Various Background.

7-12 Investigation of Methods of Improving Recognition of Objects in Early Morning and Late Afternoon.

7-13 Study of Gun Flash and Measurement of its Effect on Dark adaptation.

* 7-14 Investigation of Method for Screening out Gun Flash.

7-15 Study of Visibility of Tanks Against Various Backgrounds under Varying Conditions of Illumination.

7-16 Study of Effects of Wear and Dust on Periscopes on Visibility at Night.

* 7-17 Study of Instrument Illumination and its Effect upon Fatigue.

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P 8 Preselection Tests.

P 9 Anthropometric Measurements of Armored Force Personnel.

P 10 Test of Truck, 3/4 Ton, Improved Insulated Ambulance.

P 11 Test of Clothing, Battle, Four-Zone (OQMG-214) Cold and Arctic Zone Issues.

P 12 Test of Acousti-Guard (Ear Protective Device).

P 14 Methods of Protection Against Flash Burns.

P 16 Effect of Insulation of Transmission and Final Drive Upon the Heat Load within Tanks.

P 17 Protection of Personnel in Tanks Against Toxic Agents.

P 18 Investigation of the Effects of Activity and Environment on Atabrine Therapy.

P 20-1 The Effect of Leakage from Closures upon Thermal Protection (OQMG Test Number 57 1-A).

P 20-2 The Insulation Provided by Windbreaks (OQMG Test No. 57-11)

P 20-4 Immobilized Air (OQMG Test Number 57-IV).

P 21 Determination of the Sources, Magnitude, and Costs of Gunnery Errors.

P 22 Test of Hammock, Jungle, Impregnated with "Preventol C-4".

P 23 Test of Non-skid Paint on Tanks.

P 26 Investigation of Ear Plugs for Protection Against Gun Blast.

P 27 Fire Resisting Compounds for Clothing.

P 28 Carbon Monoxide Hazard from Exhaust Gases in Tanks that are in Tow.

P 30 Test of Acceptability and Adequacy of U. S. Army C, K; 10-in-1 and Canadian Army Mess Tin Rations.

P 34 Evaluation of the Gun Fume Hazard in the LVT A-1.

P 35 Effects Upon Tank Crews of Several Methods of Protection Against Chemical Warfare Agents.

P 36 Treatment of Mess Kits to Remove Glare.

P 37 Study of Errors in Field Artillery Practice.

P 38 Military Characteristics and Design of Observation Telescope.

P 40 Military Characteristics of Spectacle Type Binoculars.

P 41 Physiological Characteristics of the T-25 E1 - T-26 E1 Tank.

P 44 Physiological and Operational Characteristics of an M-24 Tank.

P 45 Physiological and Operational Characteristics of the T-26 E3 Tank.

P 47 Test of Telescope T122 and T123.

P 48 Report on Periscopic Sight T8 and Mount T105.

P 50 Study of Men Drinking Bursoline Treated Water in Moist Heat.

P 51 Turret Traversing Friction.

P 52 Secret. SPMDH/RC SGO.

T-1 Test of Suspenders, Pack, Field, Cargo and Combat (Support of the Pack, Field M-1944 by Means of Suspenders which Incorporate a Strap Traversing the Chest).

T-2 Test of Heat Load Imposed by Protective Clothing.

T-3 Test of Expendable Dust Respirator E5.

T-4 Test of Injuries and Burns from Rocket Launchers.

T-5 Test of Flameproofed Clothing

T-6 Test of Glasses, Sun.

T-7 Test of Carbon Monoxide Hazard from Engine in Light Tank M24.

T-8 Test of Harness, Man, M-1944 Type 1, OCMH Project No. 257-43.

T-9 NDRC Infra-Red Gas Analyzer for Carbon Monoxide.

T-10 The Design and Fit of Army Shoes

"SPHINX" Project - Secret

T-11 Heat Load Imposed by Clothing Treated to Repel Insects and Arachnids.

T-12 Test of Ear-Protective Devices, (Silents).

ILLUSTRATIONS

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TRANSPORTATION REQUIREMENTS

Present Authorization:

1 - Car, five passenger, light sedan
4 - Trucks, 1/4 ton, 4 x 4
2 - Trucks, 2½ ton, 6 x 6,cargo, w/winch
2 - Trailer, 1 ton, 2 wheel cargo
1 - Trailer, 1 ton, 2 wheel, water tank, 250 gallon

Recommended:

1 - Car, five passenger, light sedan
4 - Trucks, 1/4 ton, 4 x 4
2 - Trucks, 2½ ton, 6 x 6, cargo, w/winch
2 - Trailers, 1 ton, 2 wheel, cargo
1 - Trailer, 1 ton, 2 wheel, water tank, 250 gallon
1 - Truck 1½ ton, 6 x 6,cargo, w/winch*
1 - Ambulance 3/4 ton cross country **
2 - Trucks, Instrument Bench ***

* Required to transport groups of troops serving as test subjects to and from the field and laboratory.
** Required in the field during tests in which serious injuries may occur and develop into emergencies.
*** Required for extended test projects in locations far removed from the laboratory; trucks are fitted with supplies and equipment necessary for particular projects; personnel works on the field project from the special out-fitted truck.

Inclosure #4.

MEDICAL DETACHMENT (Proposed)

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KENTUCKY

Officers:

1 - Captain MAC - Detachment Commanding Officer and Adjutant

Enlisted Men:

2 - Master Sergeants
- 1 - First Sergeant and Chief Clerk (502) - Administrative Branch
- 1 - Foreman Auto Repair Shop (337) - Transportation Maintenance Section

3 - Technical Sergeants
- 1 - Master Mechanic (342) - Engineering Branch
- 1 - Laboratory Technician (411) - Biochemistry Section
- 1 - Laboratory Technician (858) - Environmental Physiology Section

1 - Staff Sergeant (502) - Administrative NCO in Personnel Section

4 - Technicians Third Grade
- 1 - Laboratory Technician (411) - Biochemistry Section
- 1 - Laboratory Technician (858) - General Physiology Section
- 2 - Mechanics (341) - Transportation Maintenance Section

3 - Technicians Fourth Grade
- 1 - Clerk Message Center (607) - Administrative Branch
- 1 - Mechanic - (341) - Transportation Maintenance Section
- 1 - Stock Clerk (835) - Property and Supply Section

1 - Technician Fifth Grade (014) - Auto Maintenance Mechanic - Transportation Maintenance Section

TOTAL OFFICER - 1
TOTAL ENLISTED MEN -14
GRAND TOTAL -15

Incl. #4

ARMORED MEDICAL RESEARCH LABORATORY
ORGANIZATIONAL CHART

COMMANDING OFFICER — 20 – 0 14 EM 40 – CIV
- 1 – COLONEL MC
- 1 – CLERK-STENOGRAPHER CAF – 5

CONSULTANTS

EXECUTIVE OFFICER — 5 – 0 10 – EM 30 – CIV
- 1 – LT COLONEL MC

ASSOCIATE DIRECTOR — 14 – 0 4 – EM 19 – CIV
- (DIRECTOR OF RESEARCH) – P – 8
- 1 – CLERK-STENOGRAPHER CAF – 4

ADMINISTRATIVE BRANCH — 2 – 0 9 – EM 10 – CIV
- 1 – CAPTAIN MAC* (ADJUTANT)

ENGINEERING BRANCH — 2 – 0 1 – EM 10 – CIV
- 1 – ENGINEER, GENERAL (CHIEF) P – 6
- 1 – CAPT. ENGINEER
- 1 – 1ST LT. ENGINEER
- 1 – ENGINEER UTILITIES P – 3
- 1 – INSTRUMENT MAKER SP – 8
- 1 – DRAFTSMAN, ENGINEERING SP – 7
- 1 – ENGINEERING AID SP – 6
- 1 – CARPENTER UNGRADED 15
- 1 – T/SGT MASTER MECHANIC (342)
- 2 – GUARDS CPC – 4
- 2 – JANITORS CPC – 3

LIAISON – FIELD OBSERVER BRANCH — 2 – 0
- 2 – MAJORS MC

CLINICAL MEDICAL RESEARCH BRANCH — 12 – 0 4 – EM 14 – CIV.
- 1 – CHIEF RESEARCH PHYSICIAN P – 8
- 1 – MAJ MC (ASST RESEARCH PHY)
- 1 – CLERK-STENOGRAPHER CAF – 4

STATISTICS SECTION — 3 – CIV.
- 1 – STATISTICIAN P – 4
- 2 – STATISTICAL CLERKS CAF – 5

MEDICAL DETACHMENT — 1 – 0 14 – EM
- *1 – CAPTAIN MAC
- 14 – ENLISTED MEN

PERSONNEL – RECORDS STENOGRAPHIC SECTION — 3 – EM 6 – CIV
- 1 – M/SGT CHIEF CLERK (SGT MAJOR)
- 1 – S/SGT ADMINISTRATION NCO (502)
- 1 – T/4 CLERK M CENTER (667)
- 4 – CLERK STENOGRAPHER CAF – 4
- 2 – CLERK STENOGRAPHER CAF – 3

PSYCHOLOGICAL WARFARE SECTION — 2 – 0 1 – CIV
- 1 – MAJ. MC PSYCHIATRIST
- 1 – 1ST LT. OR CAPT. MC PSYCHIATRIST
- 1 – PSYCHOLOGIST P – 4

BIOCHEMISTRY SECTION — 2 – 0 2 – EM 3 – CIV.
- 1 – CHIEF BIOCHEMIST P – 7
- 1 – BIOCHEMIST P – 4
- 1 – CAPT. SNC. BIOCHEMIST
- 1 – 1ST LT. MAC OR SNC BIOCHEMIST
- 1 – SCIENTIFIC AID (CHEMIST) SP – 4
- 1 – T/SGT LAB. TECHNICIAN (411)
- 1 – T/3 LAB. TECHNICIAN (411)

PHYSIOLOGY SECTION — 5 – 0 2 – EM 6 – CIV
- 1 – CHIEF MEDICAL PHYSIOLOGIST P – 7
- 1 – MAJOR MC PHYSIOLOGIST

BIOPHYSICS SECTION — 2 – 0 2 – CIV
- 1 – CHIEF PHYSICIST P – 7
- 1 – PHYSICAL SCIENCE AID SP – 6
- 1 – CAPT. ORD (PHYSICIST)
- 1 – 1ST LT. B I (PHYSICIST)

1 Physicist P-4

FIELD TESTING TRANSPORTATION – MAINTENANCE SECTION — 1 – 0 1 – EM
- 1 – CAPTAIN B I
- 1 – M/SGT FOREMAN AUTO REPAIR SHOP (337)
- 2 – T/3 MECHANIC (341)
- 1 – T/4 MECHANIC (341)
- 1 – T/5 MECHANIC (014)

ARCHIVES – LIBRARY SECTION — 2 – CIV.
- 1 – CHIEF LIBRARY CLERK CAF – 5
- 1 – CLERK STENOGRAPHER CAF – 3

PROPERTY AND SUPPLY SECTION — 1 W 2 – CIV.
- 1 – PURCHASING CLERK CAF – 5
- 1 – STOCK CLERK CAF – 4
- 1 – T/4 STOCK CLERK (835)

ENVIRONMENTAL PHYSIOLOGICAL SECTION — 2 – 1 1 – EM 2 – CIV.
- 1 – PHYSIOLOGIST P – 5
- 1 – PHYSIOLOGIST P – 4
- 1 – CAPT. B I (PHYSIOLOGIST)
- 1 – 1ST LT. B I (PHYSIOLOGIST)
- 1 – MEDICAL TECHNICIAN SP – 6
- 1 – T/SGT LABORATORY TECH (858)

[illegible] PHYSIOLOGY SECTION — 2 – 1 1 – EM 2 – CIV.
- 1 – [illegible] P – 5
- 1 – CAPT. ORD (PHYSICIST)
- 1 – 1ST LT. SNC. PHYSIOLOGIST
- 1 – MEDICAL TECHNICIAN SP – 6
- 1 – T/3 LABORATORY TECHNICIAN (858)

Chart #2

ARMY MEDICAL RESEARCH LABORATORY FUNCTIONAL CHART

Functions: Under the general supervision of the Army Medical Research and Development Division of the Office of the Surgeon General, U. S. Army, conducts research on the various physiological and psychological aspects dealing with the inter-relationships between man and his equipment and supplies, disease, his environment, and the military tasks assigned him with the view of constant improvement in the adaptation, training, equipment and supplies of our military forces; engages in research on clinical and physiological problems of heat and cold exposure with the view of establishment of systematic knowledge of the capacities and limitations of soldiers to live and work in naturally occurring and abnormal climates and environments; carries out projects relating to the prevention and treatment of battle fatigue and war neurosis; designs and evaluates tests for the classification and pre-selection of men for duties in the Army; develops and carries out indicated research in biochemical and biophysical aspects of physiological and clinical studies; makes anthropometric studies of personnel and of Army equipment, weapons and supplies to determine adequacies and indicated modifications for improvements.

ADMINISTRATIVE DIVISION

Functions: Coordinates, supervises and administers all matters of administrative nature, which include the following: Personnel; receipt and distribution of mail; preparation, receipt and filing of all correspondence and records; processing and distributing partial and final project reports; operation of the medical library; administers the organization and functions of the Medical Detachment; furnishes a clerk-stenographic pool for use by the other branches as required; procures, stores, and distributes all equipment and supplies, both military and civilian, required by the laboratory; supervises and performs the classification, analysis, and interpretation of numerical data collected in technical and professional research; provides and maintains transportation for the laboratory; provides drivers and personnel for the field testing of equipment and test vehicles; maintains and operates the buildings, utilities and shop, including safety procedures; alters old equipment or constructs new devices as required in the operation of the laboratory or in the performance of projects; prepares charts, diagrams or sketches for any phase of work carried on by the Laboratory.

See Chart #3

RESEARCH DIVISION

Functions: Conducts research in physiological anthropometric and psychological factors involving man, disease, military equipment, weapons and supplies, military tasks and environment; engages in research on clinical and physiological problems of heat and cold exposure; carries out projects relating to the prevention and treatment of battle fatigue and war neurosis; designs and evaluates tests for the classification and pre-selection of men for duties in the Army; develops and carries out indicated research in biochemical aspects of physiological and clinical studies; conducts anthropometric research; all work performed with the view of improving the classification and selection of men, their training, and military weapons, equipment and supplies.

See Chart #4

Chart #3

Chart #3

Chart #3

ADMINISTRATIVE DIVISION

MEDICAL DETACHMENT

Functions: Furnishes technically trained personnel to assist in the research branches; furnishes personnel for use as clerks, stenographers, drivers, and auto mechanics; accomplishes all administrative matters for the detachment, ie. personnel, pay, morning reports, etc.

PERSONNEL-RECORDS-STENOGRAPHIC SECTION

Functions: Accomplishes all matters pertaining to personnel, both military and civilian; prepares, processes and files all correspondence and routine and special reports; processes and distributes partial and final project reports; furnishes stenographic pool for other branches; receives and distributes all incoming and outgoing mail.

PROPERTY AND SUPPLY SECTION

Functions: Accounts for, requisitions, stores, and distributes all equipment and supplies, military and civilian, required by the laboratory; maintains necessary records and vouchers; expedites and traces shipments; conducts frequent inventories of supplies and equipment; maintains files of commercial catalogues.

ENGINEER SECTION

Functions: Assembles bits of equipment or constructs new items for use in experimental procedures being carried on in the research projects of the laboratory; operates a utility section for the maintenance of the grounds, buildings and equipment; operates a shop capable of woodwork, sheet metal work, and the construction of precision items of equipment; responsible for guarding the grounds, buildings and equipment; provides janitor service; drafts charts, diagrams and sketches incidental to special experimental equipment or other phases of work.

FIELD TESTING-TRANSP.-MAIN.-SECTION

Functions: Administers the motor pool; provides and maintains the authorized transportation; furnishes personnel for the field testing of equipment and test vehicles under the supervision of the research branch conducting the project.

ARCHIVES-LIBRARY SECTION

Functions: Operates library, including obtaining technical books and reports, lending them to individuals requiring them officially, assisting personnel in finding technical references and in making literature searches; maintains files of technical periodicals; receives, circulates and maintains files of technical reports from other research agencies; indexes and maintains complete file on each research project accomplished by the laboratory.

Chart #3

Chart #4

Chart #4

[illegible] DIVISION

PSYCHOLOGICAL WARFARE SECTION

Functions: Directs, plans, coordinates, and carries out such projects as may be assigned through the Commanding Officer. Institutes and carries out projects relating to the prevention and treatment of battle fatigue and war neurosis. Develops equipment and testing procedures for offensive and defensive psychological warfare, primarily mental preparation of soldiers to war. Designs and validates tests for the classification and pre-selection of men for Army duties. Develops tests to determine the degree and value of training procedures employed by Army. Cooperates with other units of the section in their experimental work, devising psychological procedures to evaluate the degree of stress placed upon the organism and advises and assists in the proper employment and evaluation of results obtained from these tests. Prepares reports on completed projects carried out under personal direction.

BIOCHEMISTRY SECTION

Functions: Directs, plans, coordinates, and carries out such chemical research projects as may be assigned or may be independently designed by the section. Organizes, supervises and develops special techniques in connection with research programs of the Laboratory, involving biochemical aspects of physiological investigations and clinical studies. Assists in the planning of the research activities of the Laboratory in cooperation with the Command. Officer, the Associate Director of Research and the heads of the various sub-sections of the Laboratory. Prepares weekly and monthly Progress Reports. Prepares Project Reports of completed research activities under his direction.

PHYSIOLOGY SECTION

Functions: Directs, supervises, and carries out the physiological and clinical research problems as may be assigned to him by the Associate Director of Research through the Chief, Research Clinical Medical Branch. Coordinates the independent research activities of the sub-sections. Formulates and edits all semi-weekly and monthly Progress Reports. Edits Progress Reports and prepares reports of completed projects carried out under his personal direction. Assists in the planning of the research activities of the Laboratory in cooperation with the Commanding Officer, the Research Director and the heads of the various sub-sections of the Laboratory.

LIAISON-FIELD OBSERVER SECTION

Functions: Performs liaison and observation of field problems in this country and in overseas theaters of operation; brings practical problems from the field into recognition by the Laboratory Staff for their perusal and subjection to the experimental approach; assists members of the Laboratory on observation duty so as to insure maximum coverage and complete analysis of field problems; brings to the attention of officers in the field the practical application of results obtained by investigation in the Laboratory and pertinent training manuals and directives; furnishes advice to the various branches and sections of the Laboratory relative to the application of their specific work projects to field problems. Prepares reports on these matters and presents information as to the applicability and practicability of the investigation by this and other Army installations.

BIOPHYSICS SECTION

Functions: Assists the Commanding Officer and Associate Director of Research in the supervision of all physical research. Assists, consults and cooperates with Staff members on other research problems involving physiological, mathematical and physical considerations. Engages in research, design, and development of visual devices and fire control instruments for armored vehicles and allied visual and optical requirements in relation to nature and use of weapons and vehicles, and physiological and anatomical limitations of the men who are involved. Designs and utilizes equipment and techniques being utilized in the physiological and clinical [illegible] research activities [illegible] direction.

STATISTICS SECTION

Functions: Advises on, administers, supervises, and performs professional and scientific work in the collection, classification, analysis and interpretation of numerical data assembled in any research problem carried on by the laboratory.

[illegible] PHYSIOLOGY

Functions: Carries out such research activities as may be assigned by the Chief of the Clinical Section or as independently designed by the section; engages in research on clinical and physiological problems of heat and cold exposures (in the Hot and Cold Rooms of the Laboratory) with the view of establishment of systematic knowledge of the capacities and limitations of soldiers to live and work in naturally occurring and abnormal climates and environments. Develops and tests protective devices and procedures for the environmental conditions under study. Cooperates with other sections in their research activities and aids in the designing and development of special technics and equipment for conducting such research. Prepares reports of completed projects carried out under personal direction.

[illegible] PHYSIOLOGY SECTION

Functions: Coordinates activity with other sections on projects relating to the functional performance of personnel as influenced by anatomical limitations. Directs, plans, and coordinates projects assigned by the Commanding Officer and initiates investigation [illegible] anthropometric studies of Army personnel. Plans and carries out projects relating physiological functions to anatomical characteristics. Prepares reports of completed projects.

The existing positional vacancies on the staff of the Armored Medical Research Laboratory to be filled by the employment of civilians are as follows. (For duties and responsibilities, see Functional Charts of respective branches and sections in Inclosure No. 4.)

	TITLE	GRADE	SALARY
1.	Research Physician, Chief of Physiological and Clinical Research	P-8	8750 - 9600*
2.	Physicist - Chief of Biophysics	P-7	7175 - 8225*
3.	Physiologist - Chief	P-7	7175 - 8225*
4.	Biochemist - Chief	P-7	7175 - 8225*
5.	Physiologist	P-6	6230 - 7070*
6.	Engineer, General - Chief	P-6	6230 - 7070*
7.	Physiologist	P-5	5180 - 6020*
8.	Physiologist	P-4	4300 - 5180*
9.	Physicist	P-4	4300 - 5180*
10.	Psychologist	P-4	4300 - 5180*
11.	Biochemist	P-4	4300 - 5180*
12.	Mechanic, General	CPC-4	1770 - 2166*
13.	Physical Science Aid	SP-6	2320 - 2980*
14.	Medical Technician	SP-6	2320 - 2980*
15.	Medical Technician	SP-6	2320 - 2980*
16.	Scientific Aid, Chemist	SP-5	2100 - 2496*

*Initial salaries are minimum on a per annum rate. Automatic increases in salary are dependent upon duration of civil service. Maximum salary attainable in the various civil service grades are starred; all benefits under civil service regulations apply.

ADDRESSEES TO CONTACT FOR FURTHER DETAILS

Persons interested in employment by the Armored Medical Research Laboratory may learn further details by contacting the following individuals:

1. **Lt. Colonel Frederick J. Knoblauch**
   Commanding Officer
   Armored Medical Research Laboratory
   Fort Knox, Kentucky

2. Chief of the Army Medical Research and Development Division
   Office of The Surgeon General
   U. S. Army
   Pentagon Building
   Washington, D. C.

3. Dr. A. J. Lanza
   Metropolitan Life Insurance Company
   1 Madison Avenue
   New York, N. Y.

4. Dr. George Smith
   Associate Professor of Anatomy
   Yale University
   School of Medicine
   New Haven, Conn.

5. Mr. William P. Yant
   Mine Safety Appliances Company
   Braddock, Thomas and Meade Streets
   Pittsburgh, Pa.

6. Dr. David B. Dill
   The Fatigue Laboratory
   Harvard University
   Morgan Hall
   Soldiers Field
   Boston, Mass.

7. Dr. I. C. Ivy
   Northwestern University
   School of Medicine
   Department of Physiology
   Chicago 11, Illinois

8. Dr. Willard Machle
   610 Park Avenue
   New York 21, N. Y.

9. Dr. Ancel Keys
   Laboratory of Physiological Hygien
   University of Minnesota
   Minneapolis, Minn.

10. Dr. Theodore Hatch
    Industrial Hygiene Foundation
    4400 Fifth Avenue
    Pittsburgh, Pa.

11. Dr. William B. Bean
    University of Cincinnati
    School of Medicine
    Department of Medicine
    Cincinnati, Ohio

12. Dr. Norton Nelson
    Pediatric Research Foundation
    Children's Hospital
    Eden and Bethesda Avenues
    Cincinnati, Ohio

Incl. #6

MASTER COPY OF PROJECTS COMPLETED

By

MEDICAL DEPARTMENT FIELD RESEARCH LABORATORY

OPERATIONS AT HIGH TEMPERATURES

VOLUME I

1. Project No. 2, 20 May 1943 - High Temperatures in Tanks. Final Report on Sub-Project 2-6, Determination of Water and Salt Requirements for Desert Operations. Nelson, Eichna and Bean.

2. Project No. 2, 12 November 1942 - Operations at High Temperatures. Sub-Project No. 2-6, Water and Salt Requirements for Desert Operations. Nelson and Bean. (Partial Report)

3. Project No. 2-7, 2-11, 2-13, 2-15, 2-17, 2-19, 18 October 1943 - Determination of Water and Salt Requirements for Jungle Operations, Influence of High Temperatures Upon the Efficiency of Personnel, Effect of Training Upon the Efficiency of Performance of High Temperatures, Study of the Effects of Drugs and Accessory Food Factors on Efficiency of Personnel at High Temperatures, Study of the Physiologic Effects of High Temperatures, Study of Efficiency of Performance and Rate of Deterioration Under Conditions of Water Limitation. Study of Men in Simulated Jungle Heat. Eichna, Bean and Ashe.

4. Project No. 2-8, 9 October 1942 - Evaporative Ambulance Cooler. Roberts and Nelson.

5. Project No. 2-8, 20 October 1942 - Effect of Desert Conditions on Personnel. Bean.

6. Project No. 2-11, 2-13, 2-17, 2 October 1944 - Influence of High Temperatures Upon the Efficiency of Personnel, Effect of Training Upon the Efficiency of Performance at High Temperatures, Study of the Physiologic Effects of High Temperatures. Eichna, Ashe, Bean and Shelley.

7. Project No. 2-11, 2-12, 2-13, 2-17, 3 April 1943 - Influence of High Temperatures on the Efficiency of Personnel, Study of Methods of Attaining and Maintaining Acclimatization to High Temperatures, Effect of Training on the Efficiency of Performance at High Temperatures, Study of the Physiologic Effects of High Temperatures. Studies of Men in Desert Heat. Bean, Eichna, Ashe, Horvath, and Nelson.

8. Project No. 2-3, 2-18, 24 November 1943 - Test of the Adequacy and Ranges of Use of Clothing for Jungle Operations, Effects of Impregnated and Impervious Clothing Upon the Efficiency of Personnel. Bean, Ashe and Eichna.

9. Project No. 2-28, 27 April 1943 - Test of Individual Crew Conditioning System. Bean and Ashe.

10. Project No. 2-29, 15 May 1943 - Test of Truck, 3/4 Ton, Refrigerated Ambulance. Walpole.

11. Project No. 2-22 (First Partial) 17 August 1943 - Determination of the Amount of Heat Transmitted to the Fighting Compartment of Tanks Under Field Conditions. Hatch, Walpole and Lawson.

12. Project No. 2-22, 8 March 1944 - Determination of the Amount of Heat Transmitted to the Fighting Compartment of Tanks Under Field Conditions. Hatch, Walpole and Lawson.

13. Project No. 22, 28 December 1943 - Test of Hammock, Jungle, Impregnated with "Preventol G-4". Bean, Eichna and Ashe.

14. Project No. 2-24, 11 May 1943 - Study of Methods of Reducing the Heat Load in Tanks. Hatch and Walpole.

15. Project No. T-11, 27 September 1945 - Test of Heat Load Imposed by Clothing Treated to Repel Insects and Arachnids. Horvath and Shelley.

16. Project No. T-2, 21 September 1945 - Ventilation Requirements of a Ventilated Suit. Test of Heat Load Imposed by Protective Clothing. Hatch, Gregg, Eichna, Horvath, Shelley and Park.

17. Project No. 16, 4 February 1944 - Effect of Insulation of Transmission and Final Drive Upon the Heat Load Within Tanks. Walpole and Lawson.

18. Project No. 2-17, 21 February 1946 - Thermal Exchanges of Man at High Temperatures. Eichna, Shelley, Horvath and Nelson.

COLD WEATHER OPERATIONS

VOLUME II

1. Project No. 1-1, 2 June 1944 - Test of the Adequacy and Ranges of Use of Winter Combat Clothing. Horvath and Hatch.

2. Project No. 1-1, 1-4, 1-5, 1-6, 18 January 1943 - Partial Report, The Adequacy and Ranges of Use of Winter Combat Clothing. Horvath and Nichna.

3. Project No. 1-1, 1-18, 10 April 1944 - Study of the Methods for Selection of Men for Cold Weather Operations. Freedman and Horvath.

4. Project No. 1-10, 11 July 1944 - Analysis of Position of Armored Force Personnel in Respect to Winter Protection with Recommendations for Use and/or Design of Suitable Equipment and Food. Horvath.

5. Project No. 1-22, 3 May 1943 - Outfit, Combat, M-1943, Experimental Test No. OQMG-140. Horvath and Freedman.

6. Project No. 1-23, 29 April 1943 - Test of Raincoat with Parka Hood; Poncho; Rainshirt, Knee Length; Raincoat, Synthetic Resin; and Tent Poncho, Sectional. Horvath and Freedman.

7. Project No. 11, 30 September 1943 - Test of Clothing, Battle, Four-Zone (OQMG-214), Cold and Arctic Zone Issues. Horvath and Freedman.

8. Project No. 20-4, 24 May 1944 - Immobilized Air (OQMG Test Number 57-IV). Horvath.

9. Project No. 20-2, 1 June 1944 - The Insulation Provided by Windbreaks (OQMG Test No. 57-11). Horvath.

10. Project No. 20-1, 14 June 1944 - The Effect of Leakage from Closures Upon Thermal Protection. (OQMG Test Number 57 I-A). Horvath, Wagar and Golden.

11. Project No. 1-11, 25 May 1944 - Influence of Cold Upon the Efficiency of Personnel. Horvath and Freedman.

12. Project No. 1-19, 16 June 1945 - Study of the Physiological Effects of Cold. Horvath, Golden and Wagar. (Second Partial Report)

13. Project No. 1-20, 9 December 1942 - Study of the Heat Retaining Capacities of Insulated Jugs. Horvath and Ashe.

14. Project No. 1-20, 18 February 1944 - Heat Retaining Capacities of Insulated Jugs. Horvath and Golden.

15. Project No. 1-21, 20 March 1943 - Test of Electrically Heated Gloves. Horvath and Freedman.

16. Project No. 1-19, 31 May 1946 - Study of the Physiologic Effects of Cold. Horvath, Golden and Wager. (Third Partial Report)

17. Project No. 57-2, 22 January 1947 - Efficiency of Signal Corps Operators in Extreme Cold. Blair and Gottschalk.

RATIONS

VOLUME III

1. Project No. 2-5, 22 October 1942 - Test of Adequacy of K-2 Ration in the Desert. Bean. (Detailed Report).

2. Project No. 2-5, 22 October 1942 - Test of Adequacy of K-2 Ration in Desert. (Supplemental Report). Bean.

3. Project No. 1, 1-7, 1-15, 2-5, 2-14, 10 April 1944 - A Critique of Army Rations: Accertability and Dietary Requirements. Bean.

4. Project No. 30, 22 November 1944 - Test of Acceptability and Adequacy of U. S. Army C, K, 10-in-1 and Canadian Army Mess Tin Rations. Bean.

5. Project No. 30, 24 March 1945 - (First Supplementary Report) - Numerical Requirements for Statistically Valid Results in Field Test of Acceptability of Rations. Bean.

6. Report on Nutrition Survey in Pacific Theater of Operations, 22 August 1945. Bean.

7. Informal Report of Observer, 17 November 1945. Bean.

ANTHROPOMETRIC STUDIES

VOLUME IV

1. Project No. T-10, 12 June 1945 - The Design and Fit of Army Shoes. Freedman, Kirkpatrick.

2. Project No. T-8, 6 March 1945 - Test of Harness, Man, M-1944, Type 1, OQMG Project No. 257-43. Freedman and Kirkpatrick.

3. Project No. T-1, 11 April 1945 - Test of Suspenders, Pack, Field, Cargo, and Combat (Support of the Pack, Field, M-1944, by Means of Suspenders which Incorporate a Strap Traversing the Chest). Freedman and Kirkpatrick.

4. Project No. 5-1, 27 November 1942 - Adequate Head Room in Tanks. Ashe, Roberts and Blair.

5. Project No. 5-12, 5 March 1943 - Seating Designing and Placing in Relation to Fatigue. Seat Design for M4 Tanks. Roberts.

6. Project No. 5-12 (Second Partial Report) 17 February 1945, Seating Designing and Placing in Relation to Fatigue. Seats for Truck (4 x 4) ¼ Ton (Peep). Roberts and Mann.

7. Project No. 5-12, 17 October 1945 - Seating Designing and Placing in Relation to Fatigue. Seat Cushions for Truck (4 x 4) ¼ Ton (Peep). Roberts and Gregg.

8. Project No. 9, 1 February 1943 - Anthropometric Measurements. Ashe, Roberts, and Bodenman.

9. Project No. 9 (Partial Report) 20 October 1945 - Size Increase of Men Wearing Various Clothing Combinations - Anthropometric Measurements. Roberts.

10. Project No. 42, 29 August 1944 - Letter Report on Test of Pack, Field, Cargo: Pack, Field, Combat; and Suspenders, Pack, Field, Cargo and Combat. Freedman.

11. Project No. 24, 13 June 1945, (First Partial) - Study of Head Protection for Tank Crews. Roberts and Mann.

12. Project No. T-13, 4 December 1945 - Survey of Foot Measurements and the Proper Fit of Army Shoes, Study of Factors Bearing on the Establishment of Size Tariffs, on Size Designations, and on Shoe Fitting. (First Partial). Freedman, Kirkpatrick and Huntington.

13. Project No. T-13, 4 December 1945 - Survey of Foot Measurements and the Proper Fit of Army Shoes, Study of Sweating of the Feet of Marching Troops. (Second Partial). Freedman and Kirkpatrick.

14. Project T-13,11 March 1946 (Third Partial) - Foot Dimensions of Soldiers. Freedman, Huntington, Davis, Magee, Milstead and Kirkpatrick.

6

15. Project T-13, 11 March 1946 (Fourth Partial) - Analysis of Characteristics of Footgear for Army Field Use. Freedman.

VENTILATION

VOLUME V

1. Project No. 3-12, 20 December 1942 - Determination of the Carbon Monoxide Hazard from Auxiliary Generators in Tanks. Nelson and Hatch.

2. Project No. 3-12, April 2, 1943 - Determination of the Carbon Monoxide Hazard from Auxiliary Generators in Tanks. (Supplementary Report). Nelson and Swigert.

3. Project No. 3-2, 18 February 1943 - Report on Gun Fume Hazard from 37 mm Gun in M5 Light Tank. Hatch, Nelson, Eichna, Walpole and Horvath.

4. Project No. 3-2, 26 April 1943 - Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M5 Series. Nelson, Eichna, Horvath and Walpole.

5. Project No. 3-1, 3-5, 22 July 1943 - Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M4 Series and Correlation of Basic Ventilation Data with Gun Fume Studies and Development of an Effective Design of Improvement for the Control of Gun Fumes in the M4 Tanks. Nelson, Eichna, Horvath and Walpole.

6. Project No. 3-1, 3-5, 15 February 1943 - Control of Gun Fumes in M4 Series Medium Tanks. Hatch, Nelson, Horvath, Eichna and Walpole.

7. Project No. 3-4, 3-6, 26 April 1943 - Determination of Basic Ventilation Characteristics of Tanks of the M4 and M5 Series. Hatch and Walpole.

8. Project No. 3-9, 24 December 1942 - Ventilation Requirements for Gas-Proofing the M5 Tanks. Hatch and Walpole.

9. Project No. 3-9, 1 March 1943 - Ventilation Requirements for Gas-Proofing Tanks of the M4 Series. Hatch and Walpole.

10. Project No. 3-9 (Second Partial) 23 June 1943 - Determination of Ventilation Requirements for Gas-Proofing Tanks of the M4 Series. Hatch, Hollingworth and Walpole.

11. Project No. 3-13, 8 April 1943 - Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons on the M7 Tank. Nelson, Horvath, Walpole and Eichna.

12. Project No. 3-15, 29 April 1943 - Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in the M4A4E1 Tank. Nelson, Horvath, Eichna and Walpole.

13. Project No. 17, 7 March 1944 - Protection of Personnel in Tanks Against Toxic Agent. Walpole.

14. Project No. 28, 11 May 1944 - Investigation of the Hazard from Exhaust Gases in Tanks that are in Tow. Nelson, Walpole and Swigert.

15. Project No. T-14, 22 October 1945 - Discussion of Ventilation Requirements of Armored Vehicles. Hatch.

16. Project No. T-7, 19 April 1945 - Test of Carbon Monoxide Hazard from Engine in Light Tank, M24. Walpole.

17. Project No. 34, 1 May 1944 - Evaluation of the Gun Fume Hazard in the LVT A-1. Nelson, Walpole, Lawson and Swigert.

18. Project No. 41 (First Partial) 19 July 1944 - Control of Gun Fume Hazard. Hatch, Nelson and Lawson.

19. Project No. 45, 28 February 1945 - Physiological and Operational Characteristics of T26E3 Tank. Brackett, Roberts, Nelson, Mann and Walpole.

20. Project No. 45, 31 July 1945 (Final Report) - Operational and Physiological Characteristics of the Tank, T26E3 (M26). Study of the Proposed Relocation of the 1000 cfm Tank Ventilating Blower to the Turret Bulge. Walpole, Nelson, and Palmes.

9

FIRE AND FLAME PROTECTION

VOLUME VI

1. Project No. 10, 12 June 1943 - Test of Truck, 3/4 Ton, Improved Insulated Ambulance. Walpole.

2. Project No. 14, 13 November 1943 - Methods of Protection Against Flash Burns. Roberts, Mann.

3. Project No. 14, 20 July 1944 - Supplemental Report on Methods of Protection Against Flash Burns. Subject - Time-Temperature Relationships Which Produce Hot Air Burns of Human Skin. Ashe, Roberts and Mann.

4. Project No. 35, 13 September 1944 - Determination of the Optimum Method for Protection of Tank Crews Against Chemical Warfare Agents. Eichna, Walpole, Shelley, and Whittenberger.

5. Project No. T-4, 8 December 1944 - Report on Test of Injuries and Burns from Rocket Launchers. Roberts and Park.

6. Project No. T-5, 17 July 1945 (First Partial) Physiologic Effects of Wearing Flameproofed Clothing in Hot Environments. Test of Flameproofed Clothing. Eichna, Horvath and Shelley.

7. Project No. T-5, 21 July 1945 (Second Partial) Effects of Wearing Flameproofed Clothing in Hot Environments. Eichna, Horvath and Shelley.

8. Project No. T-5, (Third Partial) 31 July 1945 - Effects of Wearing Flameproofed Clothing in Hot Environments. Eichna, Horvath and Shelley.

9. Project No. T-5, 28 September 1945 (Fourth Partial) - Test of Physiological Heat Load of Flameproofed Clothing. Horvath and Shelley.

10. Project No. 27, 13 March 1944 - Fire Resisting Compounds for Clothing. Ashe, Bean.

VISION IN TANKS

VOLUME VII

1. Project No. 6, 15 October 1945 - Binocular Modification Providing Quick Adjustment of Interpupillary Distance and Diopter Setting. Brackett, Roberts and Weymouth.

2. Project No. 6-1, 24 March 1945 (Partial Report) - The Advantages of Using Binoculars for Night Seeing. Brackett, Roberts and Mann.

3. Project No. 6-1, 30 April 1945 - Study of Errors in Range Estimation With the Unaided Eye. Freedman.

4. Project No. 6-1, 6-2, 6-4, 23 January 1943 - Visual Requirements, Characteristics and Limitations of Present Visual Devices in Tanks and Means for Improving Sighting Telescopes and Periscopes. Brackett.

5. Project No. 6-1, 6-2, 6-3, 6-4, 6-6, 6 September 1944 (Partial Report) - Vision in Tanks, Eye Cups, Head Rests and Head Clearances. Brackett.

6. Project No. 6-1, 6-6, 20 February 1943 - Visual Requirements for Spotting. Brackett.

7. Project No. 6-2, 9 March 1944 (Fourth Partial) - Driver's Vision in Landing Vehicle Tractor. Brackett.

8. Project No. 6-2, 7 September 1944 (Fifth Partial) - Improvement in Driver's Vision in Tanks. Fisk.

9. Project No. 6-2, 6-4, 9 June 1943 (Second Partial) - Placement and Mounting of Sights in Tanks. Brackett.

10. Project No. 6-2, 6-4, 28 December 1943 (Second Partial) - Study of Characteristics and Limitations of Present Visual Devices in Tanks and Study of Means of Improving Sighting Telescopes. (Study of M-50, M-70, T-92 and T-93 and P & E Pilot Model). Brackett.

11. Project No. 6-2, 6-4, 23 February 1944, (Third Partial) - Telescopic Sights T-106-E1 and M-71-F in Comparison with Other Tank Sights. Brackett.

12. Project No. 6-4, 27 September 1943 (Third Partial) - Lateral Offset Sight. Brackett.

13. Project No. 6-15, 14 October 1944 - Parallelogram Mounting of Reflex Sight for 50 Cal. Anti-Aircraft Machine Gun. Brackett.

14. Project No. 6, 11 October 1945 - To Discuss a Target Designating Device for Transmission of Intelligence Between Tank Commander and Tank Gunner. Roberts and Coopmans.

15. Project No. T-6, 29 March 1945 - Test of Glasses, Sun. Roberts

16. Project No. 7-1, 5 August 1943 - Determination of the Lighting Requirements for Various Tasks of Tank Crews. Roberts and Mann.

17. Project No. 7-2, 7-3, 5 December 1942 - The Use of Red Light for Maintaining Dark Adaptation in Tanks (Partial Report). Zichna and Roberts.

18. Project No. 7-2, 7-3, 25 February 1943 - Interior Lighting of M4 Tanks. Roberts.

19. Project No. 7-5, 31 May 1944 - Establishment of Criteria and Methods for the Selection of Crews for Night Operations. Roberts and Mann.

20. Project No. 7-8, 1 May 1944 - Comparison and Evaluation of Field and Laboratory Methods of Measuring Light Visual Acuity. Roberts and Mann.

21. Project No. 38, 1 May 1945 - The Military Characteristics and Design of Observation Telescope. Brackett.

22. Project No. 40, 30 May 1944 - Military Characteristics of Spectacle - Type Binoculars. Brackett.

23. Project No. 47, 7 September 1944 - Test of Telescopes T122 and T123. Brackett.

24. Project No. 48, 22 September 1944 - Report on Periscopic Sight T8 and Mount T105. Brackett.

25. Project No. 6-5, 19 April 1946 - Report on Wild Moerbrugg Rangefinder, 80cm Base, 1944. D. J. Howe

ERRORS IN GUNNERY

VOLUME VIII

1. Project No. 21 (1st Partial Report) 24 May 1944 - Determination of the Sources, Magnitude and Costs of Gunnery Errors. Hatch, Lawson and Dailey.

2. Project No. 21 (Second Partial Report) 16 June 1944 - Determination of the Sources, Magnitude and Costs of Gunnery Errors. Hatch, Lawson and Dailey.

3. Project No. 37, NDRC, SOS-11, 18 September 1944 - Study of Errors in Field Artillery Practice. Hatch and Horvath.

4. Project No. 37 (Second Partial Report) 22 March 1945 - Study of Errors in Field Artillery Practice. Hatch, Brackett, and Horvath.

5. Project No. 37 (Third Partial) 6 April 1945 - Study of Errors in Field Artillery Practice. Hatch, Brackett and Horvath.

6. Project No. 37 (Fourth Partial) 28 March 1945 - Study of Errors in Field Artillery Practice. Hatch, Brackett and Horvath.

7. Project No. 37 (Final Report) 13 June 1945 - Study of Errors in Field Artillery Practice. Hatch, Brackett and Horvath.

PHYSIOLOGICAL CHARACTERISTICS OF TANKS

VOLUME IX

1. Project No. 41 (Final Report) 8 November 1944 - Physiological and Operational Characteristics of Tank T25E1. Service Test of Medium Tank T25E1 by AMRL. Hatch, Lawson and Nelson.

2. Project No. 44. 8 November 1944 (Final Report) Physiological and Operational Characteristics of M-24 Tank. Brackett, Roberts, Nelson and Walpole.

3. Analysis of Physiological Characteristics of T9E1 Tank, 27 March 1944.

4. Physiological Characteristics of T23 Tank, 5 June 1943.

5. Suggested Modifications in the Turret of the M5A1 Tank to Improve Gunner-Commander's Position, Use of Sights and Operation of Controls. 9 August 1943. Roberts.

MISCELLANEOUS

VOLUME X

1. Project No. 18, 23 December 1943 - Investigation of the Effects of Activity and Environment on Atabrine Therapy. Nelson, Ashe, Brackett, Eichna and Bean.

2. Project No. 50, 26 May 1945 - The Physiological Effects of Ingestion of Large Quantities of Bursoline Treated Water. Nelson, Bean, Freedman, Park, Talmes and Weymouth.

3. Project No. T-3, 3 January 1945 - Test of Expendable Dust Respirator, ES, Walpole and Hatch.

4. Project No. 4-1, 10 September 1945 - Determination of Dust-Loads and Characteristics of Dusts Encountered in Operation of Armored Vehicles. Hatch and Walpole.

5. Project No. 12, 5 November 1943 - Test of Acousti-Guard (Ear Protective Device). Walpole.

6. Project No. T-12, 15 October 1945 - Test of Ear Protective Devices - Silents. Walpole.

7. Project No. 26, 5 August 1944 - Investigation of Ear Plugs for Protection Against Gun Blast. Walpole.

8. Project No. 8, 20 January 1942 - Preselection Tests. (First Partial). Ashe and Bodeman.

9. Project No. 8, 22 April 1944 - Preselection Tests. (Second Partial). Ashe.

10. Project No. 8, 17 March 1945 - Preselection Tests. (Final Report). Freedman.

11. Project No. 5-32, 5 May 1943 - Driver Fatigue in Bendix Power Control Tank No. 908 as Compared with Standard M4A2 Medium Tank. (Final Report). Ashe, Nelson and Horvath.

12. Project No. 5-29, 10 March 1944 - Development of Tests to Evaluate the Physical Fitness of Men. (First Partial). Eichna, Bean and Ashe.

13. Project No. 5-13, 24 March 1943 - Appraisal of Kind and Degree of Physical Effort Required of Tank Crews in Relation to Fatigue. Park and Swigert.

14. Project No. 5-20(Sub-Project) 9 May 1944 - Study of Schedules, Duration and Discipline of Rest Periods for Tank Crews on Long Marches. Ashe, Ross and Glenny.

15. Project No. 45, 19 June 1945 - The Physiological Work Rates of the Driver and Loader in the Tank T26E3 in Relation to Fatigue and Efficiency of Performance. Park.

16. Project No. 51, 10 October 1945 - Manual Traversing Effort in Tanks. Roberts, Mann and Riker.

17. Project No. 23, 3 June 1944 - Test of Non-skid Paint on Tanks. Hatch.

18. Project No. 36, 6 May 1944 - Treatment of Mess Kits to Remove Glare.

19. Project No. T-9, 18 May 1945 - NDRC Infra-red Gas Analyzer for Determination of Rapidly Changing Carbon Monoxide Concentrations.

20. Project No. 32, 28 July 1944 - Letter Report on Test of Socks, Cushion Sole, Experimental. Freedman.

21. Project No. 49, 15 October 1945 - Plan for Fire Control Research and Development. Brackett.

22. Project No. 5-8, 20 January 1943 - Effect of Exposure to Tank Noise Upon Hearing Acuity of Tank Crews. Hatch and Walpole.

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ARTICLES APPEARING IN PUBLICATIONS DURING 1946

Horvath, S. M.; Shelley, W. B. - Acclimatization to extreme heat and its effect on ability to work in less severe environments. American Journal of Physiology, Vol. 146 #3, June 1946.

Nelson, N.; Brackett, F. S.; Ashe, W. F.; Eichna, L. W.; Bean, W. B. - Plasma quinacrine concentration as a function of dosage and environment. Archives of Internal Medicine, Vol. 78 #1, July 1946.

Horvath, S. M.; Shelley, W. B. - Oral and rectal temperatures in hot environments. Bulletin of The U. S. Army Medical Dept., Vol. V, #4, April 1946.

Bean, W. B.; Henderson, C. R.; Richardson, L. M. - Nutrition survey in Pacific Theater of Operation. Bulletin of U. S. Army Medical Dept., Vol V #6, June 1946.

Horvath, S. M.; Shelley, W. B. - Experimental study of air blast injuries. Bulletin of U. S. Army Medical Dept., Vol. 6 #6, December 1946.

Shelley, W. B.; Eichna, L. W.; Horvath, S. M. - The effect of clothing on the ability of men to work in intense heat. Journal of Clinical Investigation, Vol. XXV #3, May 1946.

Horvath, S. M.; Golden, H.; Wager, J. - Some observations on men sitting quietly in extreme cold. Journal of Clinical Investigation, Vol. XXV #5, September 1946.

Horvath, S. M.; Shelley, W. B. - Air blast effect in a cave. Surgery, Vol. 20 #4, October 1946.

AWARDS AND DECORATIONS RECEIVED DURING 1946

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1st Lt. George C. Davis, 01785594, MC	Army Commendation Ribbon
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M/Sgt. Joseph W. Shacklette, 6984087	Army Commendation Ribbon
M/Sgt. Theodore C. Swigert, 32030465	Army Commendation Ribbon
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